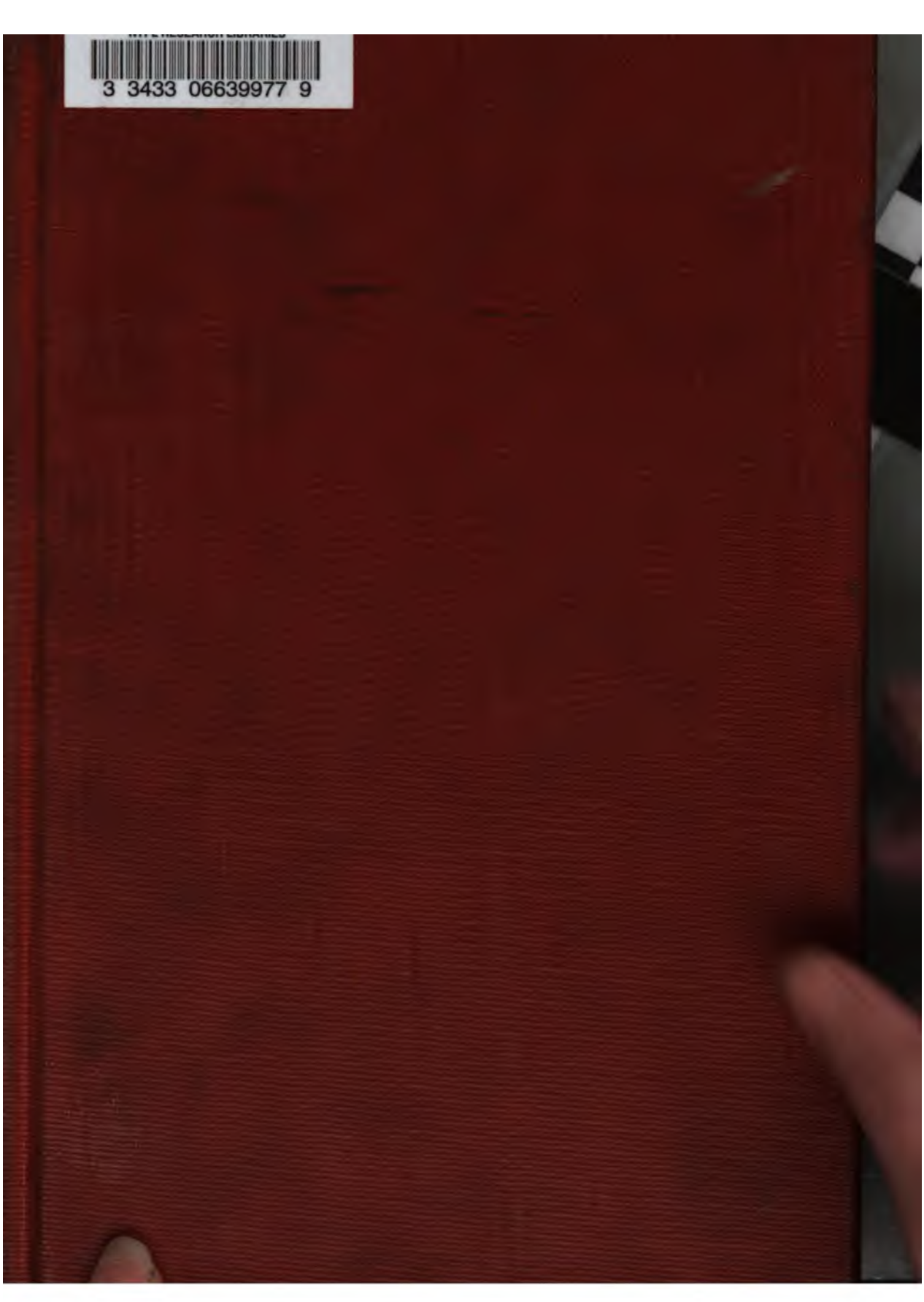

Pumps, Steam — Catalogues

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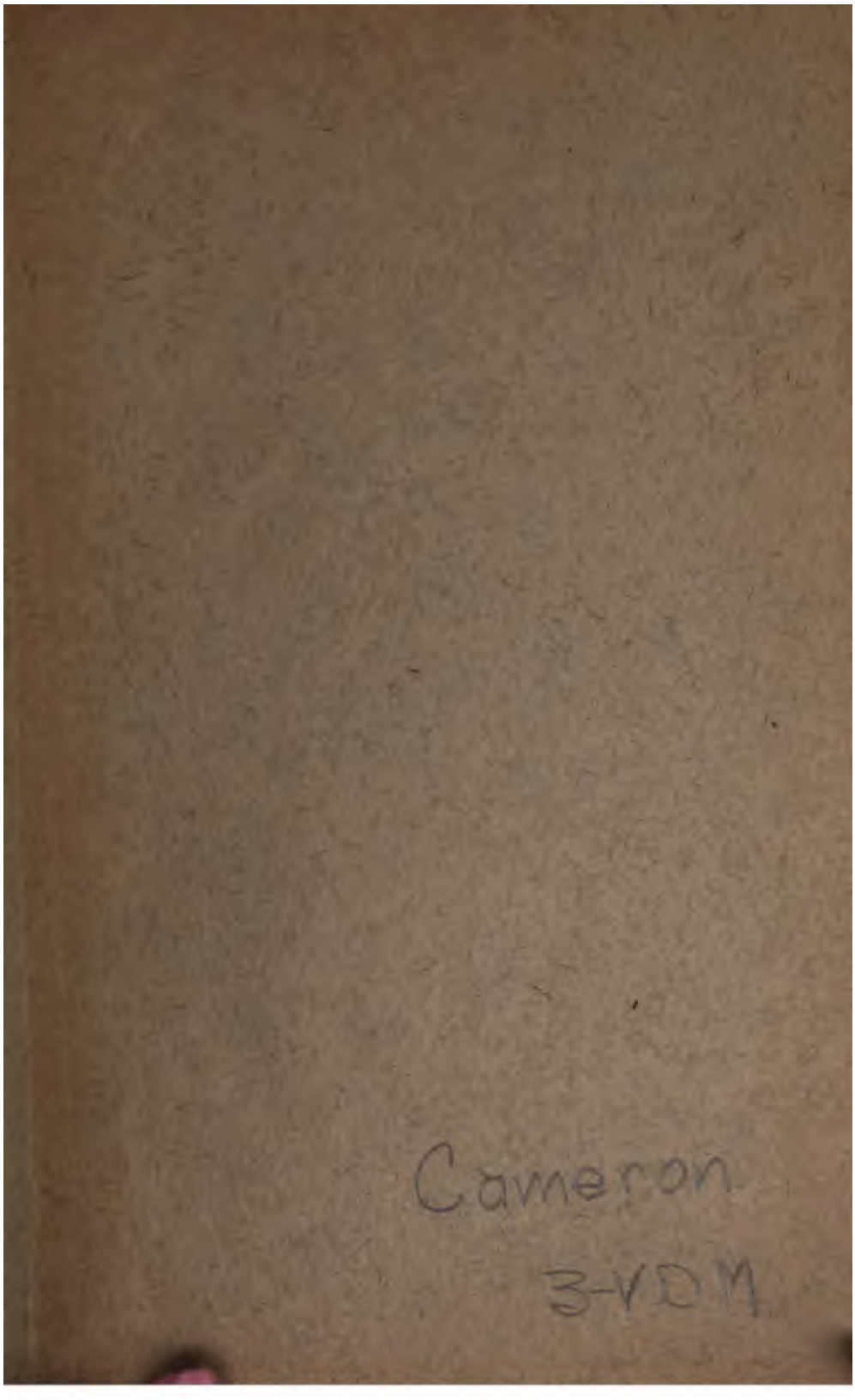

Cameron
3-YDM

A. S. CAMERON STEAM PUMP WORKS.

Steam pumps; a collection of catalogues.

A.S. CAMERON STEAM PUMP WORKS

ESTABLISHED 1860

NEW YORK, U.S.A.

CATALOGUE No. 36

REG. U.S. PAT. OFF.

Cameron Pumps

Manufactured by

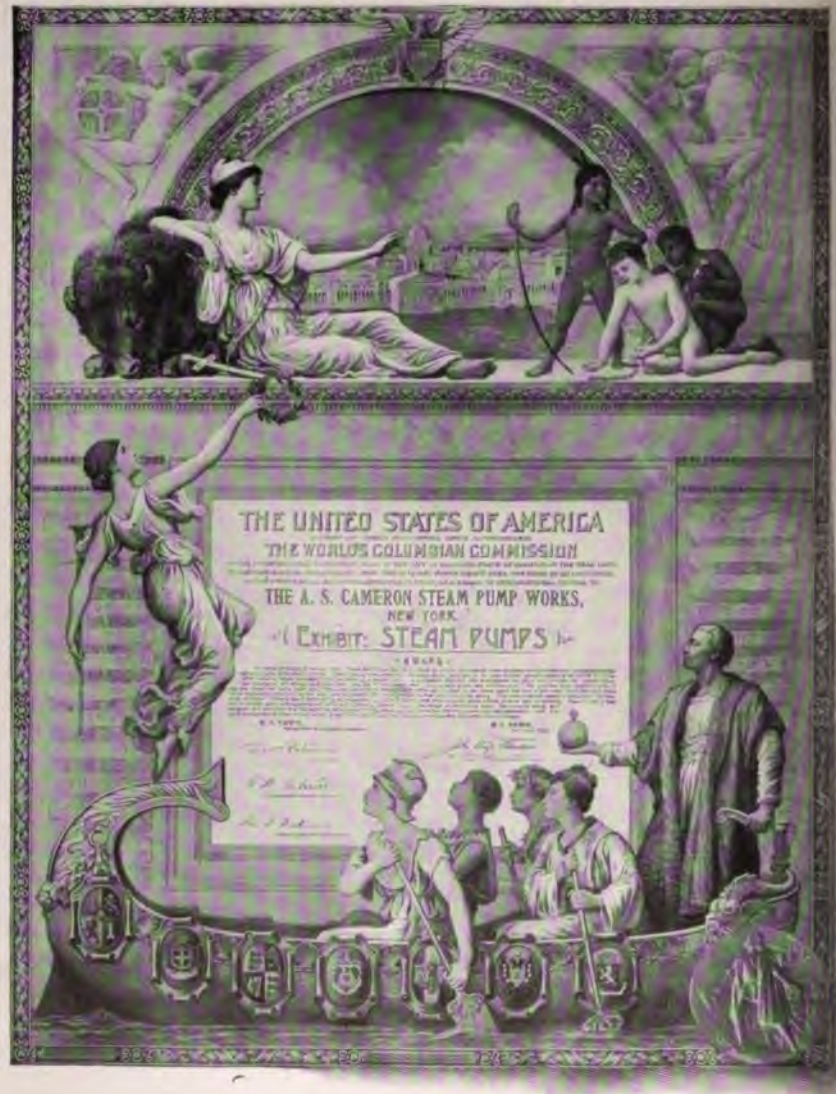
A. S. CAMERON STEAM PUMP WORKS

Foot East Twenty-third Street

New York, U. S. A.

CODES USED: ATLANTIC CABLE, WESTERN UNION, LIEBER'S A. B. C., 4th AND 5th EDITIONS, INGERSOLL-RAND MOREING & NEAL, AND MARCONI'S WIRELESS

CABLE ADDRESS, "NOREMAC" NEW YORK


THE UNITED STATES OF AMERICA
THE WORLDS COLUMBIAN COMMISSION
THE A. S. CAMERON STEAM PUMP WORKS,
NEW YORK.
EXHIBIT: STEAM PUMPS


PAN-AMERICAN EXPOSITION
BUFFALO·NEW YORK·A·D·1901
The Directors, on the recommendation of the Superior Jury, confer their award of
A SILVER MEDAL
A. S. Cameron Steam Pump Works
Steam and Air Pumps


UNITED·STATES·OF·AMERICA
UNIVERSAL·EXPOSITION·SAINT·LOUIS·MDCCCCIV
COMMEMORATING THE ACQUISITION OF THE LOUISIANA TERRITORY
THE·INTERNATIONAL·JURY·OF·AWARDS·HAS·CONFERRED·A
GOLD·MEDAL
FOR
A. S. CAMERON STEAM PUMP WORKS
STEAM PUMPS

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Anaconda Copper Mining Co. ..... Butte, Mont.
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Braschi & Co., Victor M. ..... Mexico City, Mex.
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Introductory

THE SLOGAN OF THE CAMERON—

"CHARACTER: THE GRANDEST THING."

AT the outset, we desire to express our opinion that QUALITY is as essential in Steam Pumps as in anything else, and the best is always the cheapest in the truest sense, viz., long life of satisfactory use under the most trying conditions, with maximum service and minimum cost of maintenance.

The common and indiscriminate use of the word Best, has caused it to become hackneyed and shorn of its value, and its appropriation is sometimes unwarranted and not endorsed by the public; and yet the producer must have the courage of his convictions with reference to his product, and fail not to speak boldly and openly of it. There is but one CAMERON; it is not of mushroom growth, but has stood the test of use for nearly fifty years in every clime and under all conditions; it challenges criticism, invites comparison, and commands respect by deserving it, and welcomes every opportunity to be tested.

This catalogue is our latest production and supersedes all previous issues. We have endeavored to make it attractive in appearance, of some value in the technical information it gives, and to present to intending purchasers of pumps a clear exposition and approximate idea of the various pumps we build, and a general description of their design and construction. But if the information you seek is not given herein, we shall be pleased to confer with you as to the best selection to meet your necessities. We shall be glad to hear from you direct, or through any of our agents, and we bespeak for them, for ourselves and for the CAMERON, your favorable consideration, and an opportunity to bid upon your requirements. We shall appreciate every opportunity you will give us to get into touch with you, install our pumps in your plant, and add you to our large and growing list of friends and advocates.

To Correspondents

REFERENCE to the size of the suction and discharge openings gives only approximate information as to the size and type of pump you require. It is necessary for us to have complete information to determine the diameter of the steam and water cylinders, and we therefore advise correspondents to furnish us as far as possible with the data indicated on page 12.

We keep in stock duplicate parts of nearly all sizes, and can supply any at short notice, but we must always be informed of the continuous or shop number as well as the size.

Our cylinders are made of hard, close-grained iron, and of such thickness as to permit reboring, if necessary. All pumps, unless otherwise ordered, are fitted with valve seats of best composition, and arranged to handle fresh, cold water. But if required to handle feed water of high temperature, they will be supplied with the proper valves and packing. If they are to be operated with steam at a high pressure, beyond say 150 pounds, that fact should be stated, so that the proper provision can be made in the design and construction. We build pumps designed to resist the action of various corrosives, such as pumps with iron valve fittings for cyanide products, or with entire water cylinders of solid composition of acid metal.

We do not aim to give our pumps a fancy appearance, since all workmanship is devoted to the machine itself, and no labor is expended on ornamentation. We are always prepared, however, to furnish pumps for engine rooms or other situations finished in any style desired, at prices which will include merely the extra cost to us.

All prices in this catalogue are for goods delivered on steamer's dock or cars at New York, including skidding, which is included in the weights given in the catalogue.

Our terms are net 30 days, and without discount for anticipation of payment. Accounts overdue subject to sight draft.

IF you are seeking a pump that is cheap and nothing else, we have to say that we do not attempt to compete in price with the cheaper short-lived pumps.

Our policy, steadily pursued ever since the inception of our business, has been to build the very best pump that the best of material and most skillful workmanship can produce, and time has, we think, demonstrated the wisdom of refusing to sacrifice, on the score of cheapness, the high quality of workmanship and material, but more especially the excellence of design, which renders the CAMERON durable beyond all others, and its few working parts readily and easily replaceable. Moreover, we believe, in buying a CAMERON you will save money in cost of repairs.

Besides other sterling qualities, the three points of excellence peculiar to the CAMERON are: First, Simplicity; second, Durability; third, Entire absence of outside valve gear or moving parts.

SIMPLICITY—The CAMERON pump has fewer working parts than any other steam pump made.

DURABILITY—The steam mechanism consists of four stout pieces only, none of them delicate, intricate or exposed to injury. The operation of this mechanism is such that—

While under full pressure of steam, the suction pipe may be lifted out of the water and the pump allowed to run away or race as fast as steam will drive it, without danger of the piston striking the heads or any injury to the pump. The advantage of this can scarcely be exaggerated, since under most conditions any pump is liable to have its supply of water cut off unexpectedly. They are made stronger and heavier than other pumps of the same capacity.

ABSENCE OF OUTSIDE VALVE GEAR—The steam valve movement works in line with the piston rod without the intervention of arms or levers. The pump can, therefore, be run, without danger of breaking, at a greater speed than any pump employing an outside valve movement. There are no rods to become bent, broken or get out of alignment, no tappet bars, rollers or clamps to be adjusted.

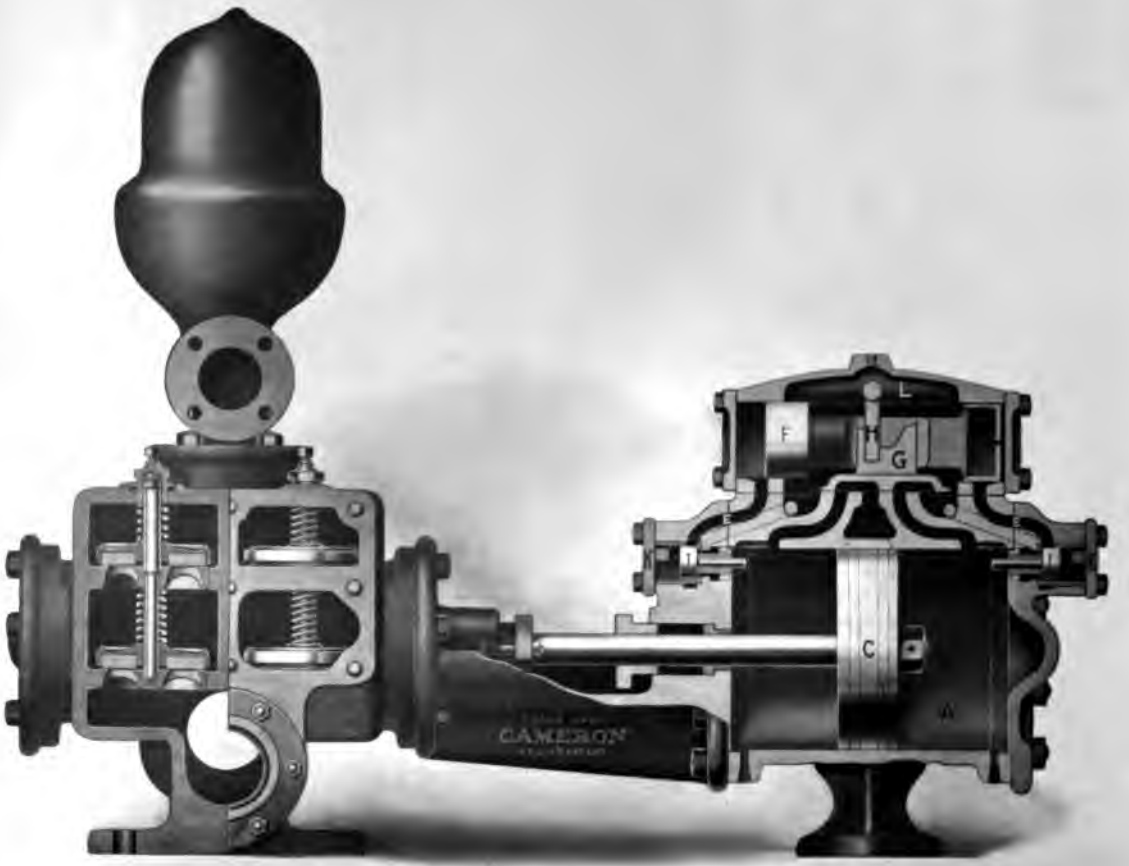
There have been placed on the market more or less recently several pumps with inside steam mechanism and an absence of outside valve gear. Examination will show that they lack the simplicity claimed for them. Some of these pumps, sold for boiler feeding, are equipped with deflecting valves for turning their exhaust steam into the suction. The oil or any lubricant from the cylinder thus carried in with the feed water is highly injurious to the boiler, and the practice is severely condemned by boiler insurance inspectors. On the other hand, the steam mechanism of CAMERON pumps is entirely without minute steam ports, grooves, packing rings or other complicated devices, and the pumps themselves are especially noted for their ability to perform exacting service and work under trying conditions. They can stand almost any amount of rough usage, and we find they often do stand a great deal of abuse.

There being no dead center the pump will always start at any point of the stroke, and can be run so slowly that the eye can hardly detect the motion of the piston rod.

The pump can be completely taken apart without disconnecting any of the pipes.

Every pump sold by us is thoroughly tested before leaving the works, and is fully guaranteed to be exempt from any faulty construction and from defects of material or workmanship. Its satisfactory operation is also guaranteed on condition that it is properly set up, reasonably cared for and used for a service and capacity corresponding to its proportions and design.

We call attention to the separate Code word for each type of pump, which is a new feature in this catalogue, and for use in telegraphing about the type of pump when referring to sizes or combinations that are not listed.



SECTIONAL VIEW OF CAMERON REGULAR PATTERN PISTON PUMP

Simplex vs. Duplex

MANY inaccurate statements and unwarranted claims have been advanced in behalf of duplex pumps. Several makers go as far as to state that their duplex pumps are "double the capacity of single pumps of the same diameter and stroke," a misrepresentation which we can hardly let pass unnoticed. In the first place a CAMERON pump can be run safely and comfortably at a speed that would knock a duplex pump with its lever arm contrivances all to pieces. But even at a low speed duplex pumps seldom attain even their theoretical capacities, and the reason for this is neither mysterious nor difficult of comprehension. In all duplex pumps each steam piston is controlled and reversed by a connection with the opposite piston rod. Since it is beyond human ingenuity to pack two machines so that friction will be equal, it follows that one piston must move more sluggishly than the other, and this piston is constantly interrupted and reversed before it has a chance to complete its stroke. One pump is constantly short stroking. If you don't believe this measure the actual strokes of the two rods and compare them and note what becomes of the claimed capacity.

A CAMERON pump cannot reverse until it has completed its full, honest stroke.

A CAMERON pump can be run continuously and without detriment at greater speed than any duplex pump made.

For two reasons duplex pumps are prodigally extravagant in the use of steam. First, because of the wasted clearance of steam in the cylinder whose piston is not traveling its full stroke. Second, because duplex pumps have double the number of ports, and steam spent in filling ports is steam wasted.

A duplex pump has more than double the number of parts to keep in repair, and when any one gives out the whole machine is crippled.

In nearly all duplex plunger pumps sold so cheaply and cheerfully for boiler feeding and other purposes, there is no possible way of compensating for wear—the more the water plunger wears the more churning and less pumping is done. Of course, the "parts can be renewed"—the oftener, the more there is in it for the maker.

Every CAMERON pump is packed to compensate for wear.

Directions for Ordering

IN order that we may be able to answer your inquiry intelligently, and to save time, please inform us as far as possible upon the following points:

What is the liquid to be pumped?

If water, is it hot or cold? Is it pure, or does it contain salt, acid, sulphur, sand or grit?

What is the average quantity to be pumped per minute? What is the maximum that the pump might be called upon to handle?

How high is the liquid to be forced?

How far—that is, what is the length of discharge pipe?

If pipe is already laid, what is its diameter and how many turns does it make?

What is the steam pressure at the pump?

Will the pump exhaust into the atmosphere? If against back pressure, how much?

What is the height of suction lift—how far above water will the pump be placed? What is the total length of suction pipe? And how many elbows or turns?

Directions for Setting Up and Running Pumps

BLOW out steam pipe thoroughly before connecting up your **pump.** Any dirt or rubbish carried into a steam cylinder will **cut and** wear it away.

After pump is connected remove reverse valve covers or **plugs, take out valves and blow steam** through. Then carefully wipe **valves and pockets clean before replacing** the former.

Never use smaller pipe than size given in tables. Long pipes should be of even greater diameter to allow for increased friction. This applies particularly to suction pipe.

Run pipe as nearly in a direct line as you can. Turns and elbows greatly increase friction, and all bends should be as large and gradual as possible.

In cold weather, open the drip cocks to drain the steam and water cylinders, otherwise they may burst if allowed to freeze.

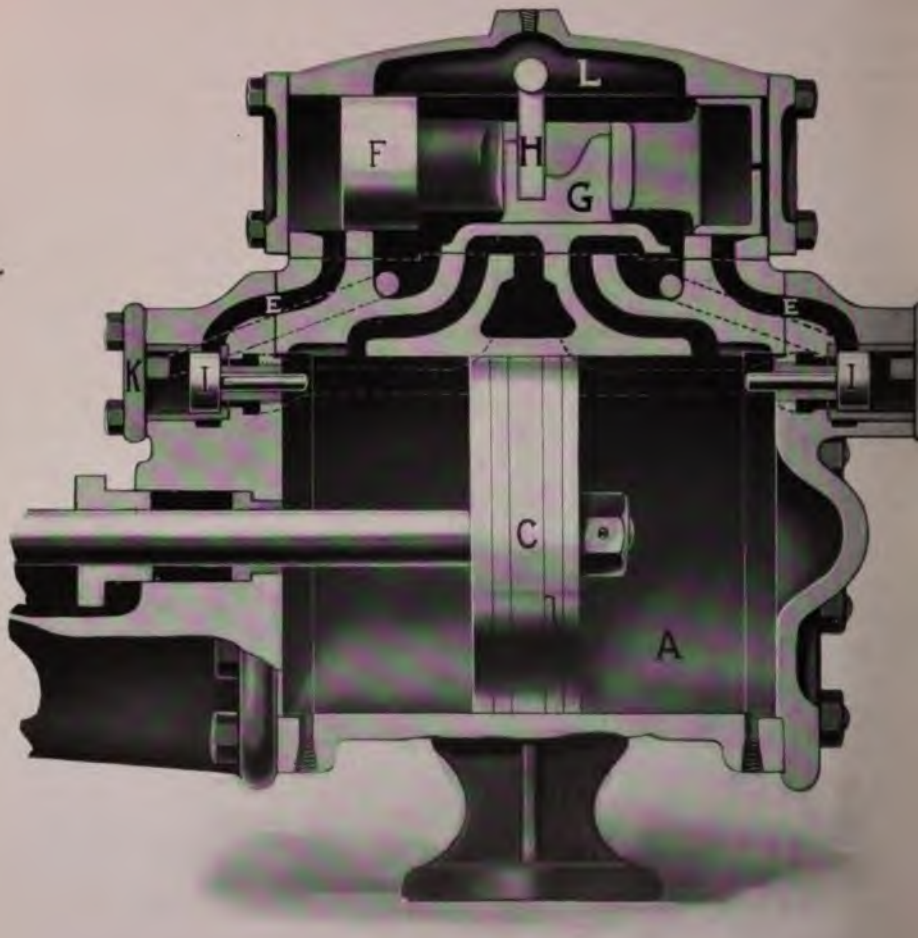
Suction pipe must be absolutely tight, and it is always well to use a foot valve and strainer.

Place your pump as near the water as possible. At sea level water will rise 33.9 feet in a perfect vacuum, but practically no steam pump can draw water to anything like such a height by suction. Hot water cannot well be lifted by suction, since its vapor destroys the necessary vacuum. Therefore, to pump hot water the supply should be placed above pump and delivered to it from a head.

A vacuum chamber upon the suction pipe, close to the pump, is always an advantage, and on long lines of pipe or on pumps running at high rate of speed is absolutely necessary. Its utility consists in causing a steady and uniform flow of the liquid through the suction pipe, and thus preventing "pounding" or water hammering, which (without one) is always incident to long suctions.

When working under very heavy duty put an air cock in the suction pipe between the vacuum chamber (should there be one) and the pump, and by admitting a small quantity of air keep the air chamber supplied. The surplus air, passing with the water into the discharge pipe, forms an elastic column, preventing water hammering and consequent shock on the pump and pipes.

Do not use tallow in the steam cylinder, but a little of the best refined mineral, sperm or lard oil. Any oil that corrodes or gums the working parts is unfit for use.



SECTIONAL VIEW OF REGULAR CAMERON STEAM END

Cameron Steam End

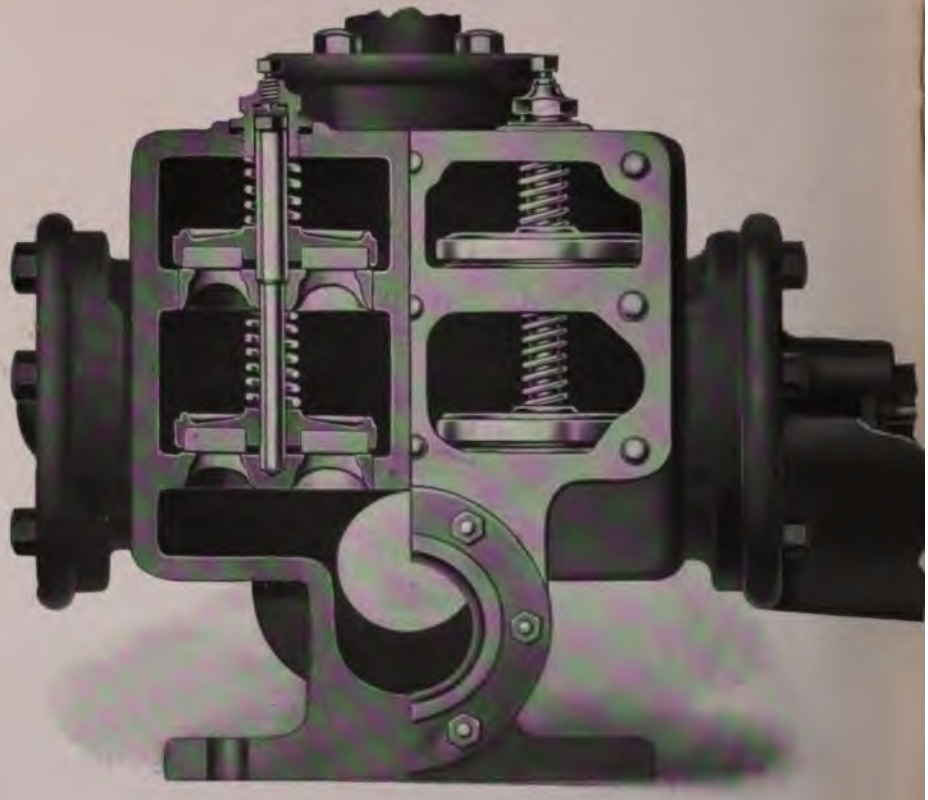
ALL single, direct-acting pumps make use of an auxiliary plunger to carry the main slide valve, which gives steam to the main piston. By means of various devices steam pressure is made to drive this auxiliary plunger backward and forward. In the CAMERON pump the plunger is reversed by means of two plain tappet valves, and the entire mechanism thus consists of four stout pieces only, all working in direct line with the main piston. Simple and without delicate parts, it is the only inside valve gear that is absolutely reliable.

Explanation

A is the steam cylinder; *C*, the piston; *L*, the steam chest; *F*, the chest plunger, the right-hand end of which is shown in section; *G*, the slide valve; *H*, a lever, by means of which the steam-chest plunger *F* may be reversed by hand when expedient; *II* are reversing valves; *KK* are the reversing valve chamber bonnets, and *EE* are exhaust ports leading from the ends of steam chest direct to the main exhaust and closed by the reversing valves *II*.

Operation

C, the piston, is driven by steam admitted under the slide valve *G*, which, as it is shifted backward and forward alternately connects opposite ends of the cylinder *A* with the live steam pipe and exhaust. This slide valve *G* is shifted by the auxiliary plunger *F; F* is hollow at the ends, which are filled with steam, and this, issuing through a hole in each end, fills the spaces between it and the heads of the steam chest in which it works. Pressure being equal at each end, this plunger *F*, under ordinary conditions, is balanced and motionless; but when the main piston *C* has traveled far enough to strike and open the reverse valve *I*, the steam exhausts through the port *E* from behind that end of the plunger *F*, which immediately shifts accordingly and carries with it the slide valve *G*, thus reversing the pump. No matter how fast the piston may be traveling, it must instantly reverse on touching the valve *I*. In its movement the plunger *F* acts as a slide valve to close the port *E*, and is cushioned on the confined steam between the ports and steam-chest cover. The reverse valves *II* are closed as soon as the piston *C* leaves them by a constant pressure of steam behind them conveyed direct from steam chest through the ports shown by dotted lines.



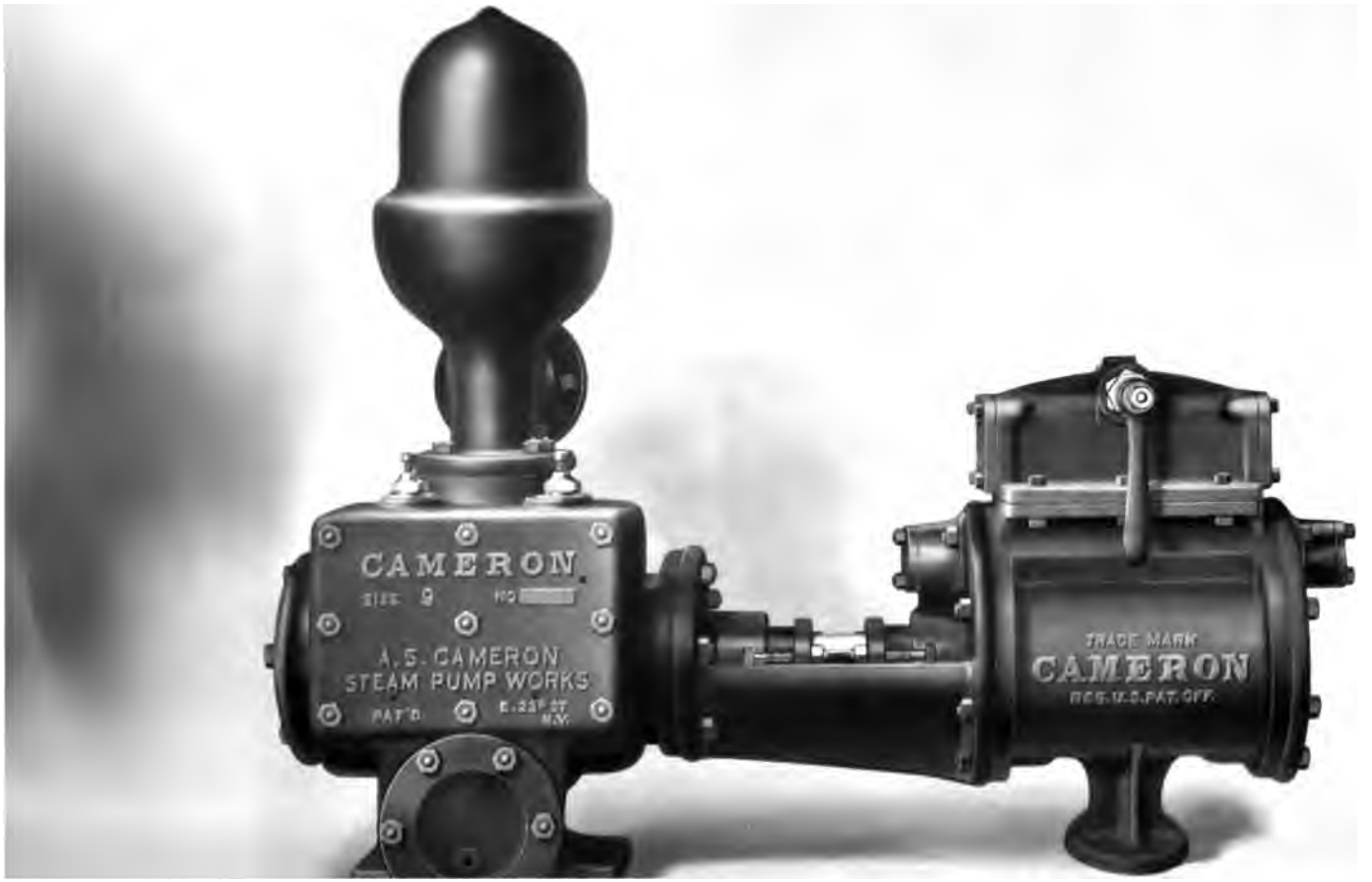
REGULAR CAMERON WATER VALVE CHEST

One-half in Section and the Other with Bonnet Removed.

Regular Cameron Water Valve Chest

THE illustration on opposite page shows the CAMERON valve chest and arrangement of valves. The right-hand side is shown in full as it appears when bonnet is removed and the left-hand side in section. The superiority of this valve chest lies in its accessibility. By simply removing one bonnet or cover, the whole interior with every valve is plainly visible, turned inside out so to speak, and not a speck of anything that may have lodged there can escape detection. The shelves or decks are bored out tapering, and the brass seats forced in. They can thus be readily taken out and renewed at any time. Each stem holds two valves, with their springs one above the other, so that by simply unscrewing one plug, and pulling up the stem, both are released. It will be noticed that the CAMERON valve chest is placed close to the ground and beside the water piston, instead of above it as in other makes. The valves are therefore just so much nearer the water, and the suction lift is reduced accordingly. Every pump has two suction openings, one on each side, and the discharge opening can be turned in any direction desired.

REGULAR CAMERON WATER END—REAR VIEW

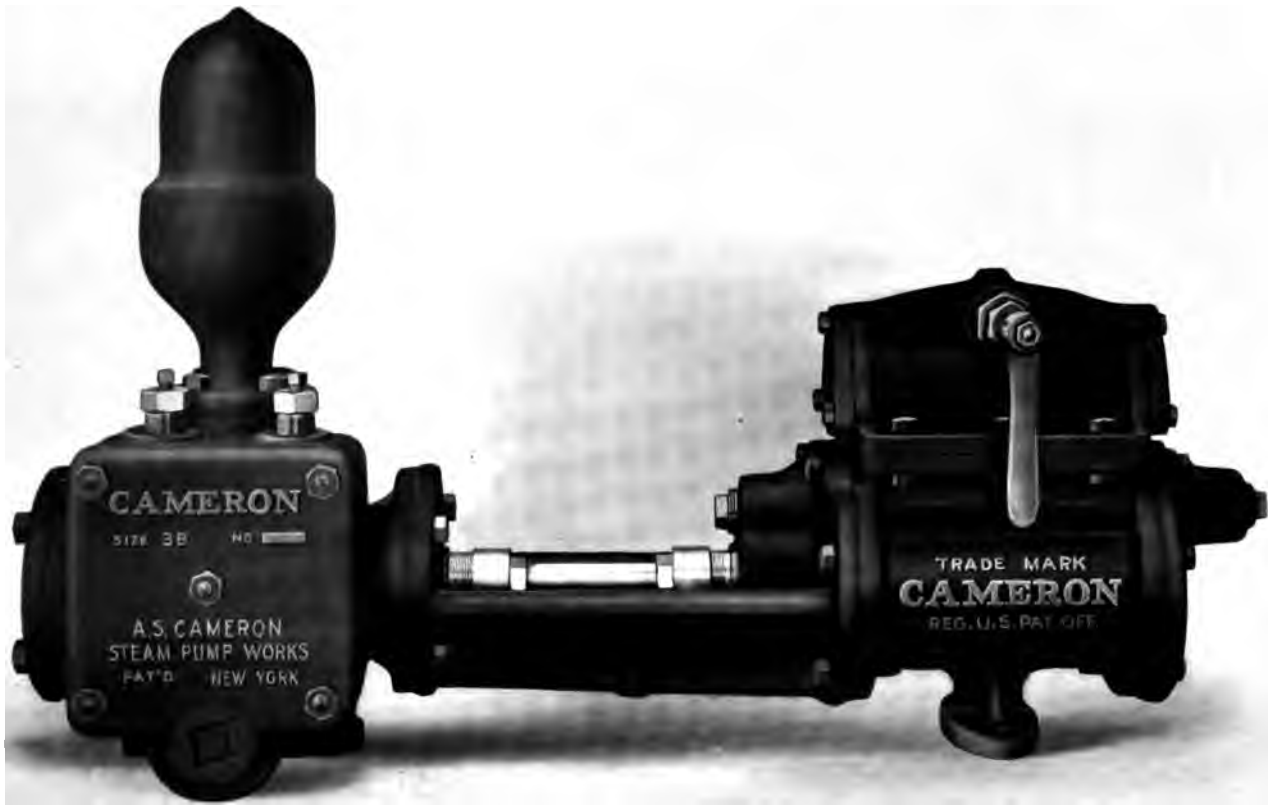

CAMERON
SIZE 9
A. S. CAMERON
STEAM PUMP WORKS
PAT'D
TRADE MARK
CAMERON
REG. U.S. PAT. OFF.

Cameron Regular Pattern Piston Pump for General Service

Sizes 0 to 4a are made as illustrated on page 20, other sizes as illustrated on page 18, except size 11 and larger, which have a series of valves.

Code Word*	Size Number	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed, per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Floor Space Inches	Weight
Aba	0	$80	$85	3½	2	4	.054	8	⅜	1¼	1¼	1	32 x 9	136
Abaco	1	120	125	4	2	6	.081	12	⅜	1¼	1¼	1	40 x 10	210
Abalak	2	140	150	5	2½	6	.12	18	½	¾	1½	1¼	40 x 11	260
Abbadia	3	165	175	6	3	7	.21	28	¾	1	2	1½	47 x 13	418
Abbeville	3a	185	200	6	3½	7	.29	38	¾	1	2½	2	47 x 15	435
Abbot	4	210	225	7	3½	7	.29	38	¾	1	2½	2	47 x 15	459
Abenberg	4a	235	250	7	4	7	.39	50	¾	1	2½	2	51 x 16	457
Aberford	5	275	290	7	3½	12	.5	50	1	1½	3	2½	58 x 17	820
Aberlady	5b	325	350	7	5	13	1.10	100	1	1½	4	3	63 x 20	1117
Abita	6	325	340	8	4	12	.65	65	1	1½	3	2½	58 x 18	864
Abrego	6a	350	375	8	5	13	1.10	100	1	1½	4	3	63 x 20	1160
Abries	7	375	400	10	5	13	1.10	100	1¼	2	4	3	64 x 21	1315
Abriola	8	400	425	10	6	13	1.59	150	1¼	2	4	3½	64 x 21	1411
Abruzzo	9	470	520	12	7	13	2.16	200	1½	2½	5	4	66 x 24	1928
Abukir	10a	540	575	14	8	13	2.83	261	2	3	5	5	73 x 26	2548
Abury	10	....	....	14	9	18	4.96	330	2	3	6	5	81 x 30	3126
Abusabel	11	....	....	16	10½	18	6.75	450	2½	4	8	6	90 x 37	4920
Abydos	12	....	....	18	12	20	9.80	587	3	4	10	8	103 x 41	6080

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcil."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocil."**



REGULAR BOILER FEED PATTERN. Code word, "Rearfeed"

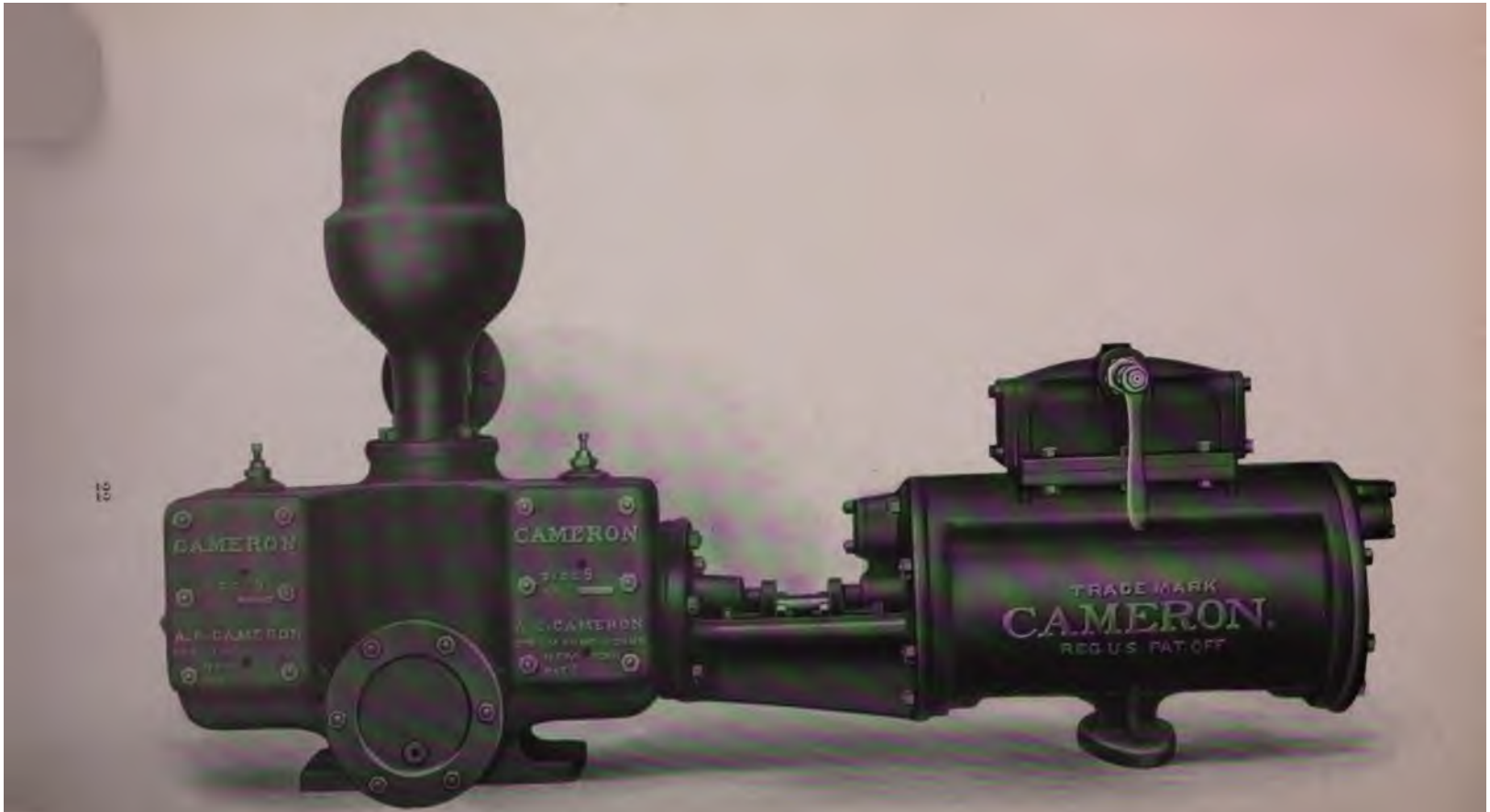
Cameron Piston Pump—Regular Boiler Feed Pattern

The main difficulty met with in fixing on the proper size of pump to recommend is that the horse-power of the boiler for which the pump is required, is about all the information furnished. The expression "horse-power," as applied to boilers, is a very indefinite term; what should be given, if possible, is the quantity of feed water required, and a pump which will supply this quantity at about one-half its rated capacity at ordinary speed will be right for cold water, and say one-third speed for hot water.

In feeding hot water the pump should be placed below the source of supply. Sizes 0 to 3b are made as illustrated on page 20. Other sizes as illustrated on page 18, except size 16x10½x18 and larger, which have a series of valves.

Code Word*	Size Number	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Boilers, in Horse Power they will supply at moderate speed based on 30 lbs. of Water per Horse Power per hour	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Floor Space Inches	Weight
Acadia	0	$80	$85	3½	2	4	40	⅜	½	1¼	1	32 x 9	136
Acampo	1	120	125	4	2	6	60	½	½	1¼	1	40 x 10	210
Acari	2	140	150	5	2½	6	90	½	¾	1½	1¼	40 x 11	260
Accous	2a	150	165	5	3	7	140	½	¾	2	1½	47 x 12	347
Acebo	2b	160	170	5	3½	7	190	½	¾	2½	2	47 x 14	355
Achim	3b	210	225	6	4	7	250	¾	1	2½	2	47 x 14	444
Achonry	3c	210	225	6	3½	12	325	¾	1	3	2½	58 x 17	508
Ackley	3d	230	245	6	4	12	425	¾	1	3	2½	58 x 17	525
Acores	5a	280	310	7	4½	12	525	¾	1	3	2½	58 x 18	725
Acorn	5b	325	350	7	5	13	670	1	1½	4	3	63 x 20	1117
Acquaro	..	390	415	9	6	13	1000	1	1½	4	3½	64 x 21	1202
Acritas	..	445	490	10	7	13	1325	1¼	2	5	4	66 x 24	1770
Acton	..	500	530	12	8	13	1725	1½	2½	5	5	73 x 26	2010
Acula	..	...	...	14	9	18	2200	2	3	6	5	81 x 30	3125
Acushnet	..	...	...	14	10	18	2670	2	3	6	5	81 x 30	3300
Acuto	..	...	...	16	10½	18	3000	2½	4	8	6	90 x 37	4920
Acworth	..	...	...	16	12	20	4000	2½	4	10	8	103 x 41	5140

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcil."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocil."** For boiler feed pumps with outside packed plungers see page 49.



LONG STROKE PUMP. Code word, "Longstroke"

Cameron Long Stroke Piston Pump

This type is especially adapted for rolling mills, blast furnaces, sugar or oil refineries, and other situations where continuous pumping is required. Its piston stroke being nearly twice the length of that of the "regular" type, all working parts, except pistons and rod, are brought into action only half the number of times for the same piston speed; wear and tear is reduced and the life of the pump prolonged accordingly. Valve chests are placed at both ends of the water cylinder, thus making the water passages short and direct.

Code Word*	Size Number	Price, with Iron water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Length Over All Inches	Height Over All Inches	Width Over All Inches	Weight
Agar	7	$450	$500	10	5	25	2.12	115	1¼	2	5	3½	87	45	22	1687
Agattoo	8	475	525	10	6	25	3.0	170	1¼	2	5	3½	87	45	22	1741
Agincourt	9	550	600	12	7	25	4.17	225	1½	2½	6	4	90	57	24	2345
Agna	10	....	....	14	9	33	9.08	350	2	3	8	6	118	70	30	4235
Agorda	11	....	....	16	10½	33	12.37	500	2½	4	10	8	122	74	36	5732
Agreda	12	....	....	18	12	38	18.60	660	3	4	12	10	142	92	42	7830

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcll."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocll."**


TRADE MARK
CAMERON
CAMERON
A.S.CAMERON
STEAM PUMP WORKS

Cameron Regular Light Service Piston Pump

This pump is adapted for filling tanks, irrigating and light duty generally, on railways, in factories, and for situations where a considerable quantity of water is to be lifted to a limited elevation. It is not designed for mining work, nor to force water against heavy lifts. In light service duty, the pressure on the valves being low, the pump can therefore be run faster, thus obtaining a greater capacity than given in list. The photographic reproduction illustrates size 7x7x13.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Alabaster	$140	$150	4	3	7	.21	28	¾	1½	2	1½	335
Alabat	150	160	4	3½	7	.29	38	¾	1½	2½	2	346
Aladan	160	170	5	3½	7	.29	38	1	2	2½	2	358
Alagoa	160	170	4	4	7	.39	50	¾	1½	2½	2	345
Alameda	170	180	5	4	7	.39	50	1	2	2½	2	360
Alamo	210	225	5	5	7	.60	80	1	2	3	2½	553
Alaqua	230	250	6	5	7	.60	80	1	2	3	2½	628
Alba	275	300	6	6	7	.86	115	1	2	4	3	800
Alberona	285	310	7	6	7	.86	115	1	2	4	3	824
Alberton	380	435	7	7	13	2.16	200	1	1½	5	4	1540
Albiano	400	450	8	7	13	2.16	200	1	1½	5	4	1575
Albidona	425	465	9	7	13	2.16	200	1	1½	5	4	1680
Albizzate	445	490	10	7	13	2.16	200	1¼	2	5	4	1800
Albondon	410	450	7	8	13	2.83	261	1	1½	5	5	1630
Alcaraz	420	460	8	8	13	2.83	261	1	1½	5	5	1660
Alcudia	....	....	8	9	13	3.58	330	1	1½	6	5	2050
Aldaya	....	....	8	9	18	4.96	330	1	1½	6	5	2200
Aldbrough	....	....	9	9	13	3.58	330	1	1½	6	5	2260
Alderbrook	....	....	10	9	13	3.58	330	1¼	2	6	5	2320
Alegria	....	....	10	9	18	4.96	330	1¼	2	6	5	2520
Aleksin	....	....	8	10	13	4.42	400	1	1½	6	5	2022
Alemania	....	....	8	10	18	6.12	400	1	1½	6	5	2230
Aleppo	....	....	10	10	13	4.42	400	1¼	2	6	5	2303
Alfooras	....	....	10	10	18	6.12	400	1¼	2	6	5	2535
Algonac	....	....	10	10½	18	6.75	450	1¼	2	8	6	3641
Alhama	....	....	10	12	20	9.80	587	1¼	2	10	8	4550
Aliaga	....	....	12	12	20	9.80	587	1½	2½	10	8	4900
Alida	....	....	10	14	20	13.32	800	1¼	2	12	10	4800
Alipoor	....	....	12	14	20	13.32	800	1½	2½	12	10	4950
Alken	....	....	14	14	20	13.32	800	2	3	12	10	5450
Allapee	....	....	12	16	20	17.40	1050	1½	2½	12	10	7500
Allariz	....	....	14	16	20	17.40	1050	2	3	12	10	8000
Almas	....	....	16	16	20	17.40	1050	2½	4	12	10	8650

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcil."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocil."**


CAMERON
A.S.CAMERON
STEAM PUMP WORKS
NEW YORK
PATENTED
TRADE MARK
CAMERON

Cameron Piston Pump—Removable Bushing Pattern

Where mine water is very gritty and the use of a plunger pump is prohibited on account of limited space or other circumstances, to secure the greatest durability possible with a piston pump, we supply a removable bushing of iron or composition. This bushing can be turned in the pump so that the wear, which is usually greatest on the bottom, can be gradually distributed over every portion of its surface. Furthermore, if, from the deepening of the mine, it becomes necessary for the pump to be placed lower, the removable bushing can be replaced by one of smaller diameter, thus changing the proportions of the pump, and enabling it, within certain limits, to work against a greater head. The photographic reproduction illustrates No. 9, size 12x7x13.

Code Word*	Size Number	Price, with Iron Bushing and Steel Piston Rod	Price, with Bushing, Piston and Piston Rod of Composition	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Stroke of Piston Inches	Capacity per Stroke, in Gallons	Capacity at Ordinary Speed per Minute, in Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Anabara	0	$85	$90	3½	2	4	.054	8	⅜	½	1¼	1	136
Anacapri	1	130	135	4	2	6	.081	12	⅜	½	1¼	1	210
Anajaz	2	150	160	5	2½	6	.12	18	½	¾	1½	1¼	260
Anamosa	3	175	185	6	3	7	.21	28	½	1	2	1½	418
Anapa	3a	200	215	6	3½	7	.29	38	¾	1	2½	2	435
Anco	4	225	240	7	3½	7	.29	38	¾	1	2½	2	459
Ancroft	4a	250	265	7	4	7	.39	50	¾	1	2½	2	457
Andar	5	290	305	7	3½	12	.5	50	1	1½	3	2½	820
Andover	5b	350	375	7	5	13	1.10	100	1	1½	4	3	1117
Anegada	6	340	355	8	4	12	.65	65	1	1½	3	2½	864
Angeja	6a	375	400	8	5	13	1.10	100	1	1½	4	3	1160
Angellas	7	400	425	10	5	13	1.10	100	1¼	2	4	3	1345
Angerlo	8	430	455	10	6	13	1.58	150	1¼	2	4	3½	1411
Anholt	9	500	550	12	7	13	2.16	200	1½	2½	5	4	1928
Aniba	10a	575	610	14	8	13	2.83	261	2	3	5	5	2548
Anklam	10	....	....	14	9	18	4.96	330	2	3	6	5	3126
Anselma	11	....	....	16	10½	18	6.75	450	2½	4	8	6	4920
Anta	12	....	....	18	12	20	9.90	587	3	4	10	8	6080

*If pump with iron bushing and steel piston rod is desired, add the word **"Ironbush."** If pump with bushing, piston and piston rod of composition is desired, add the word **"Compobush."**

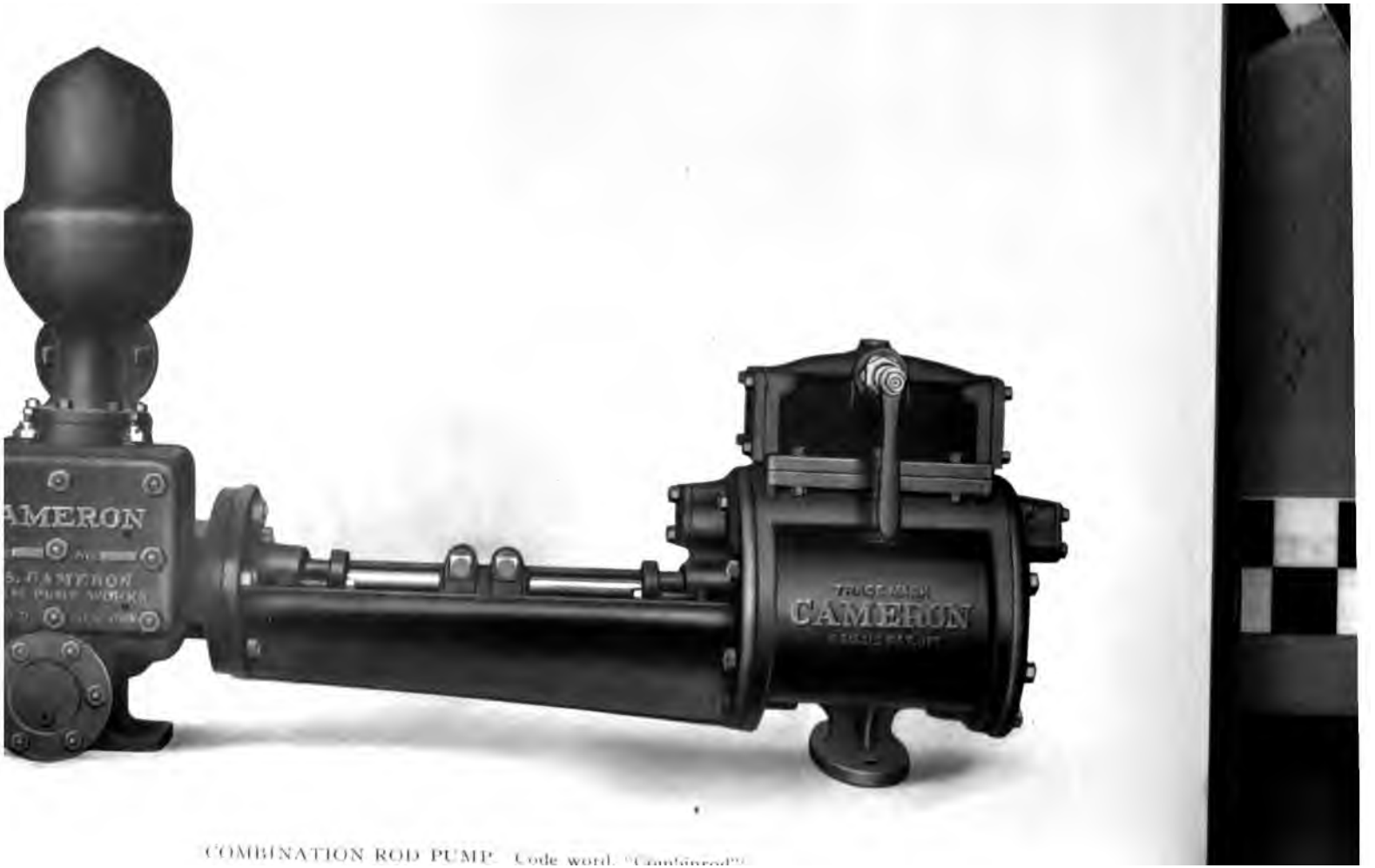
FIRE PUMP. Code word, "Firepump"

Cameron Piston Fire Pump

This fire pump has large openings, and is made more than usually strong to withstand heavy strains, or to be run at a very high speed in cases of emergency. Like all our pumps, it will start at any point by simply turning on steam, and will run as fast as steam will drive it without danger of the piston striking the cylinder covers. Each pump is supplied with a neck having four openings for fire hose connections, or will be altered to suit special situations, as for instance, with one or more flanged openings. It is provided with sight feed lubricator, priming valves, air valves, vacuum chamber, and the steam cylinder is equipped with drip pipe and globe valves. The photographic reproduction illustrates size 12x6x13.

Code Word	Size	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Number and Size of Hose Connections	Number and Size of Fire Streams and Distances Thrown Horizontally*	Floor Space Required Inches	Weight
Apia	A	$310	8	4	12	.65	1	1½	3	4–2½	1–1″, 100′	58 x 18	864
Appleby	B	400	10	5	13	1.10	1¼	2	4	4–2½	1–1″, 150′	64 x 21	1345
Applegate	C	500	10	5	25	2.12	1¼	2	5	4–2½	1–1″, 150′	87 x 21	1687
Appodi	D	520	12	6	13	1.58	1½	2½	5	4–2½	1–1⅛″, 175′ or 2–1″, 100′	65 x 24	2025
Apulia	E	600	14	7	18	3.00	2	3	5	4–2½	1–1¼″, 200′ or 2–1″, 150′	75 x 28	2512
Apure	F	900	16	8	18	3.90	2½	4	6	4–2½	1–1⅜″, 225′ or 3–1″, 125′	82 x 33	3536

*The vertical height would be about 25 per cent. less.



COMBINATION ROD PUMP. Code word, "Combined"

Cameron Piston Pump with Long Body Piece and Combination Rod

In some situations where the water end must be packed very tightly, or where the liquid to be pumped is strongly impregnated with acid, the piston rod is liable to become worn down or corroded at one end much more rapidly than at the other. In such cases the rod becomes of unequal diameter at opposite ends and the larger part cannot pass through the packing of the stuffing box of the water end if it is packed tightly enough to avoid leakage. To remedy this, we can supply an extra long body piece, so that no part of the rod will enter both stuffing boxes, and when so desired we make the rod in two pieces, joined together by a clamp nut, as shown in the illustration on the opposite page. This permits of the steam end rod being of steel and the water end of bronze. Thus the latter, which wears more rapidly, may be readily renewed as often as necessary without incurring the expense of replacing an entire rod. The photographic reproduction illustrates size 10x5x13.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Arabat	$310	$325	7	3½	12	.5	50	1	1½	3	2½	920
Ardelan	360	375	8	4	12	.65	65	1	1½	3	2½	960
Ardenno	420	445	10	5	13	1.10	100	1¼	2	4	3	1450
Ardferd	515	565	10	5	25	2.12	115	1¼	2	4	3½	1890
Ardoch	450	475	12	5	13	1.10	100	1½	2½	4	3	1800
Arena	575	625	12	5	25	2.12	115	1½	2½	4	3½	2490
Arenzano	500	550	12	6	13	1.58	150	1½	2½	4	3½	1700
Arganil	600	650	12	6	25	3.00	170	1½	2½	5	3½	2532
Argenta	520	570	12	7	13	2.16	200	1½	2½	5	4	2050
Argus	625	675	12	7	25	4.17	225	1½	2½	6	4	2580
Aricati	590	640	14	7	18	3.00	200	2	3	5	4	2780
Aripo	710	760	14	7	25	4.17	225	2	3	6	4	3160
Arkadias	....	....	16	8	18	3.90	261	2½	4	5	5	3880
Armonk	....	....	16	8	25	5.44	290	2½	4	6	5	4750
Arnot	....	....	18	9	20	5.50	330	3	4	6	5	4640

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcil."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocil."**

OIL LINE PUMP. Code word, "Oiline"

Cameron Oil Line Piston Pump

This pump is designed for handling crude or refined petroleum on pipe lines where the oil must be pumped a considerable distance through pipe of small diameter. It is fitted with either leather-faced valves and a leather cup piston for handling cold oil, or valves of composition and a hemp-packed piston for pumping oil at a high temperature. We supply this pump with a plain iron water cylinder, or fitted with a removable composition bushing of a peculiar form best adapted for this class of work. All these pumps have composition piston rods. The photographic reproduction illustrates size 12x3x13, and shows pump with composition bushing. This style of composition bushing is furnished on some sizes only, the bushings of other sizes being made without flange.

Code Word*	Price, with Iron Oil Cylinder and Composition Piston Rod	Price, with Piston Rod and Removable Bushing of Composition	Diameter of Steam Cylinder, Inches	Diameter of Oil Cylinder Inches	Stroke of Piston Inches	Capacity per stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Asahan	$175	$195	6	3	7	.21	28	¾	1	2	1¼	445
Asam	215	235	7	3	7	.21	28	¾	1	2	1½	470
Asaro	280	300	7	3½	12	.50	50	1	1¼	3	2	820
Asbach	330	350	8	3	12	.36	40	1	1¼	3	2	938
Asbury	440	475	10	3	13	.39	40	1¼	2	3	2	1745
Ascea	440	475	10	3½	13	.54	50	1¼	2	3	2	1783
Ascona	440	475	10	4	13	.70	65	1¼	2	3	2	1760
Ascope	440	475	10	4½	13	.90	80	1¼	2	3	2	1760
Asculan	440	475	10	5	13	1.10	100	1¼	2	4	3	1345
Asek	515	550	12	3	13	.39	40	1½	2½	3	2	1890
Ashapoo	515	550	12	3½	13	.54	50	1½	2½	3	2	1930
Ashburn	515	550	12	4	13	.70	65	1½	2½	3	2	1794
Ashby	515	550	12	4½	13	.90	80	1½	2½	3	2	1758
Ashford	515	550	12	5	13	1.10	100	1½	2½	4	3	2309
Ashkelon	650	725	12	3	25	.75	40	1½	2½	4	3	2600
Ashley	650	725	12	3½	25	1.04	50	1½	2½	4	3	2600
Ashmont	650	725	12	4	25	1.35	65	1½	2½	4	3	2600
Ashton	650	725	12	5	25	2.12	100	1½	2½	4	3	2600
Ashwood	650	725	12	6	25	3.00	150	1½	2½	4	4	3200
Asiago	725	800	14	3½	25	1.04	50	2	3	5	3	3100
Asir	725	800	14	4	25	1.35	65	2	3	4	3	3100
Asla	725	800	14	5	25	2.12	100	2	3	4	3	3483
Asola	725	800	14	6	25	3.00	150	2	3	5	4	3500
Asoph	1025	1100	16	4	25	1.35	65	2½	4	4	3	4200
Assabet	1025	1100	16	5	25	2.12	100	2½	4	4	3	4204
Assonet	1025	1100	16	6	25	3.00	150	2½	4	5	4	4205
Assur	1125	1225	18	4	25	1.35	65	3	4	4	3	5700
Astara	1125	1225	18	5	25	2.12	100	3	4	4	3	5700
Astrabod	1125	1225	18	6	25	3.00	150	3	4	5	4	5700

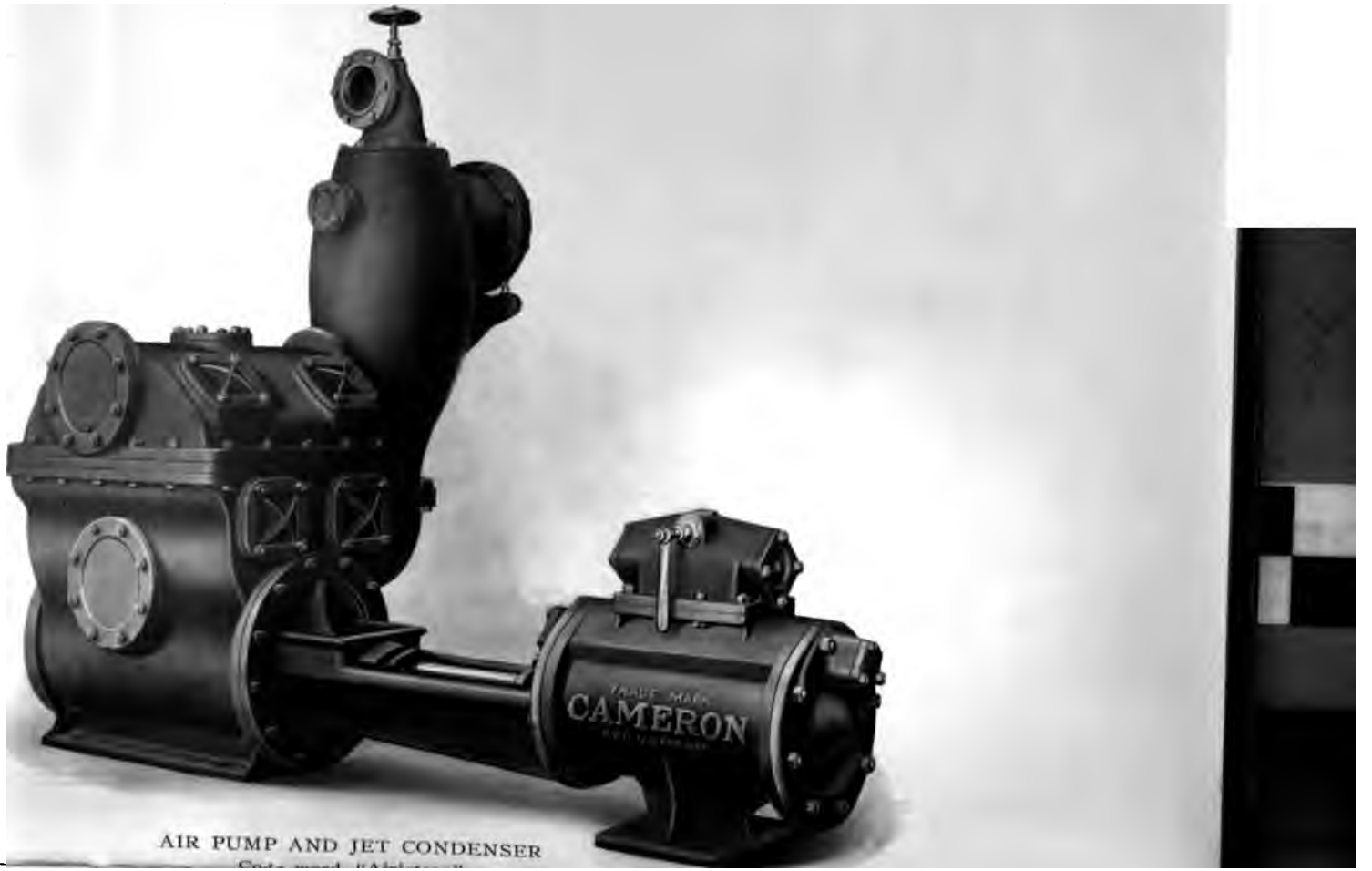
*If pump with iron oil cylinder and composition piston rod is desired, add the word **"Ironoilcil."** If pump with piston rod and removable bushing of composition is desired, add the word **"Combusholl."**


TRADE MARK
CAMERON
REG. U.S. PAT. OFF.
CAMERON STEAM PUMP

Cameron Horizontal Piston Pump—Waterworks Pattern

The pump illustrated under this heading has unusually large valve area and passageways, and is only built in large sizes. The suction chamber is in the bed plate under the water cylinder. We have furnished a large number of these pumps for situations where piston pumps were well suited, and they are highly esteemed. They are very massive, strong and durable, and designed for continuous service under conditions which render desirable smooth running machines, making but little noise, as for waterworks. The photographic reproduction illustrates size 24x18x36.

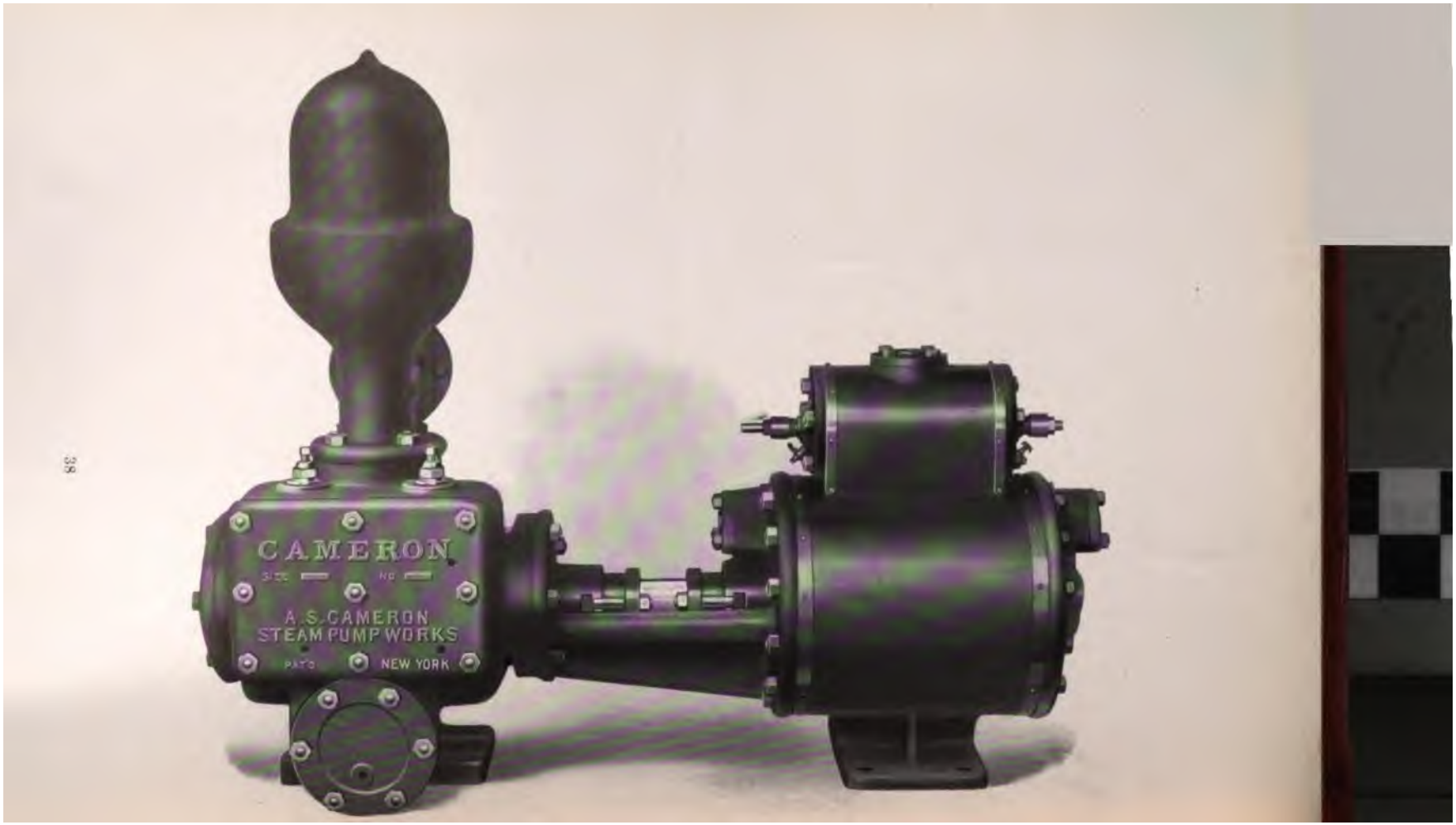
Code Word	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Stroke of Piston Inches	Capacity per Stroke, Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Awalt	.....	16	16	36	31.32	1050	2½	4	12	12	15500
Awatska	.....	18	16	36	31.32	1050	3	4	12	12	16000
Axbridge	.....	20	16	36	31.32	1050	4	5	12	12	17300
Axel	.....	22	16	36	31.32	1050	4	5	12	12	17600
Axiopolis	.....	24	16	36	31.32	1050	4	5	12	12	18000
Axley	.....	18	18	36	39.66	1300	3	4	14	12	16070
Axtell	.....	20	18	36	39.66	1300	4	5	14	12	17350
Aybar	.....	22	18	36	39.66	1300	4	5	14	12	17650
Aylsham	.....	24	18	36	39.66	1300	4	5	14	12	18250
Ayotla	.....	26	18	36	39.66	1300	5	6	14	12	19350
Azalia	.....	28	18	36	39.66	1300	5	6	14	12	19650
Azamoor	.....	20	20	36	48.96	1600	4	5	14	12	17850
Azani	.....	22	20	36	48.96	1600	4	5	14	12	18150
Azaughal	.....	24	20	36	48.96	1600	4	5	14	12	18750
Azeglio	.....	26	20	36	48.96	1600	5	6	14	12	19750
Aziak	.....	28	20	36	48.96	1600	5	6	14	12	20000
Azof	.....	30	20	36	48.96	1600	5	6	14	12	20350
Azotus	.....	32	20	36	48.96	1600	5	6	14	12	20700



AIR PUMP AND JET CONDENSER

CAMERON condenser features are embodied which render it as perfect as it [redacted] an apparatus of this kind. The injection is controlled by a valve of such construction that, by a few turns of the handle, any impediment may be swept away by a larger stream of water. There is provided an automatic arrangement by means of which air is admitted to the condenser and the vacuum broken when the water rises too high, preventing the flooding of the steam cylinder. The photographic reproduction illustrates size 16x20x24.

Code Word	Price	Diameter of Steam Cylinder Inches	Diameter of Air Cylinder Inches	Stroke of Piston Inches	Steam Pipe	Exhaust Pipe	Suction Pipe	Delivery Pipe	Weight
Mocha	.....	6	8	12	¾	1	4	4	1550
Modum	.....	8	10	12	1	1½	5	5	2220
Moerdyk	.....	10	12	18	1¼	2	6	6	3020
Mogaung	.....	10	14	18	1¼	2	8	8	4650
Mohalitz	.....	12	16	18	1½	2½	8	8	4890
Mohamet	.....	12	18	18	1½	2½	8	8	6600
Mohamiss	.....	12	18	24	1½	2½	10	10	7000
Moira	.....	14	18	24	2	3	10	10	7200
Mojola	.....	16	20	24	2	3	10	10	7500
Moldau	.....	16	22	24	2	3	12	12	9750
Molina	.....	18	24	24	2½	4	12	12	11100


CAMERON
SIZE
NO
A. S. CAMERON
STEAM PUMP WORKS
PATD
NEW YORK

Cameron Pump for High Steam Pressures

WHEN the steam pressure exceeds 150 lbs. per square inch, it is advisable, if not absolutely necessary, to use a form of steam valve differing from that ordinarily used. It is a generally recognized fact that the best form of valve to work under these conditions is the piston type, and this we have adopted.

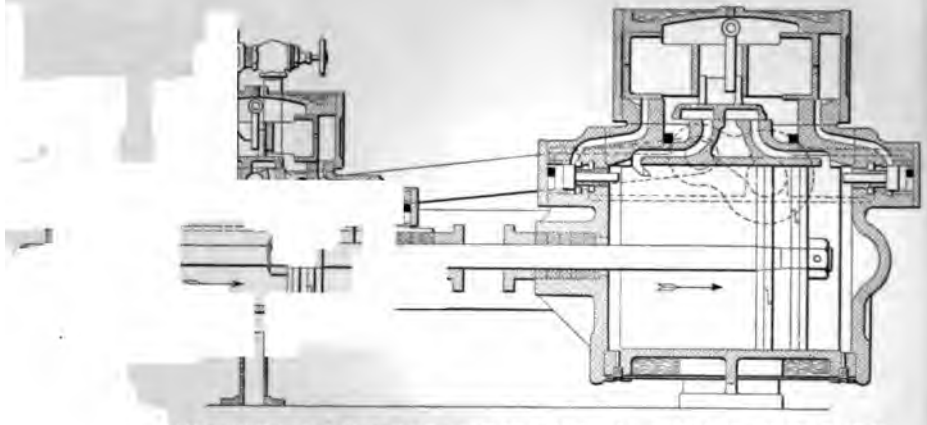
In lieu of the steam chest, plunger and slide valve shown on page 14, we make the plunger to constitute the valve as well as plunger, and cast the chest on the steam cylinder and force into it a liner having the ports accurately milled in it. The steam cylinder and its flanges, and the parts bolted to it, are all made extra heavy, and the bolts are larger and closer together than in our pumps, as adapted for ordinary steam pressures.

The steam plunger thus arranged is practically balanced, and has very little tendency to wear, and none to stick or bind, thus rendering it more positive than one carrying a slide valve.

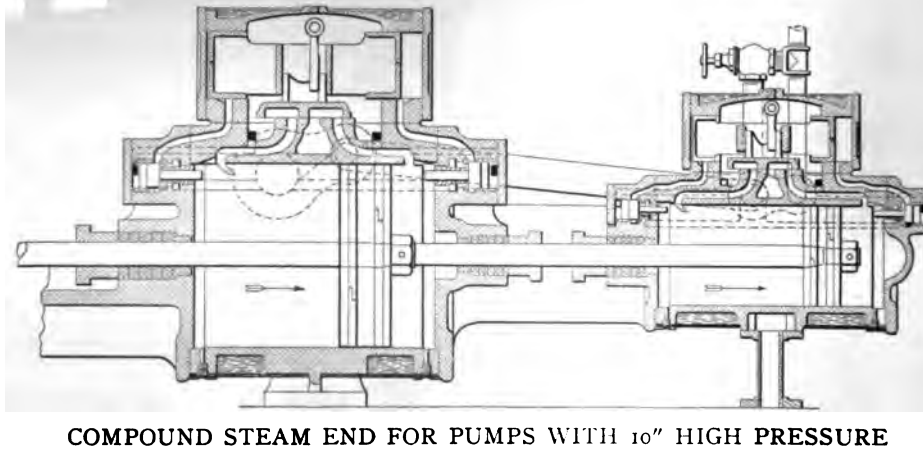
Nearly all of our vertical and horizontal marine pumps have this plunger valve, and the high pressure cylinders of compound pumps are thus equipped in many cases.

We can arrange our various designs with this type of high pressure steam cylinder complete, including the lagging, at a slight increase in price. Net prices on any combination quoted on application.

The photographic reproduction on opposite page illustrates our "Regular Pattern" Piston Pump equipped with this type of cylinder.



ND STEAM END FOR PUMPS WITH 9" HIGH PRESSURE
STEAM CYLINDER AND SMALLER



COMPOUND STEAM END FOR PUMPS WITH 10" HIGH PRESSURE STEAM CYLINDER AND LARGER

Cameron Compound Steam End

A GLANCE at the drawings on the opposite page will make evident the truth of our assertion in regard to the extreme simplicity of our compound steam end, in which both the high and low pressure cylinders are of the CAMERON Standard type and have all the peculiar characteristics which render it thoroughly reliable.

The steam mechanism consists of a few working parts of substantial character; it is without any outside valve gear and absolutely positive in action and requires no more skill to run it than a simple pump, from the fact that it operates without the introduction of arms or levers and it cannot be, and does not require to be, adjusted. It will be noticed that the lines of reciprocation of every moving part are parallel with those of the pistons, and all move in the same direction.

The advantages to be derived from compounding are considerable as effecting the economical consumption of steam, which saving is greatly enhanced by the use of a condensing apparatus; but the steam saving does not comprise the whole benefit gained, as it has been found in practice that a pump thus arranged is capable of running faster and smoother under a heavy load than with a simple stem end. We lag both cylinders with sheet metal over a thick layer of non-conducting material, thus reducing the condensation very considerably and diminishing the cause of the greater loss in steam driven machines.

SINGLE COMPOUND PISTON PUMP. Code word, "Regsingcom"

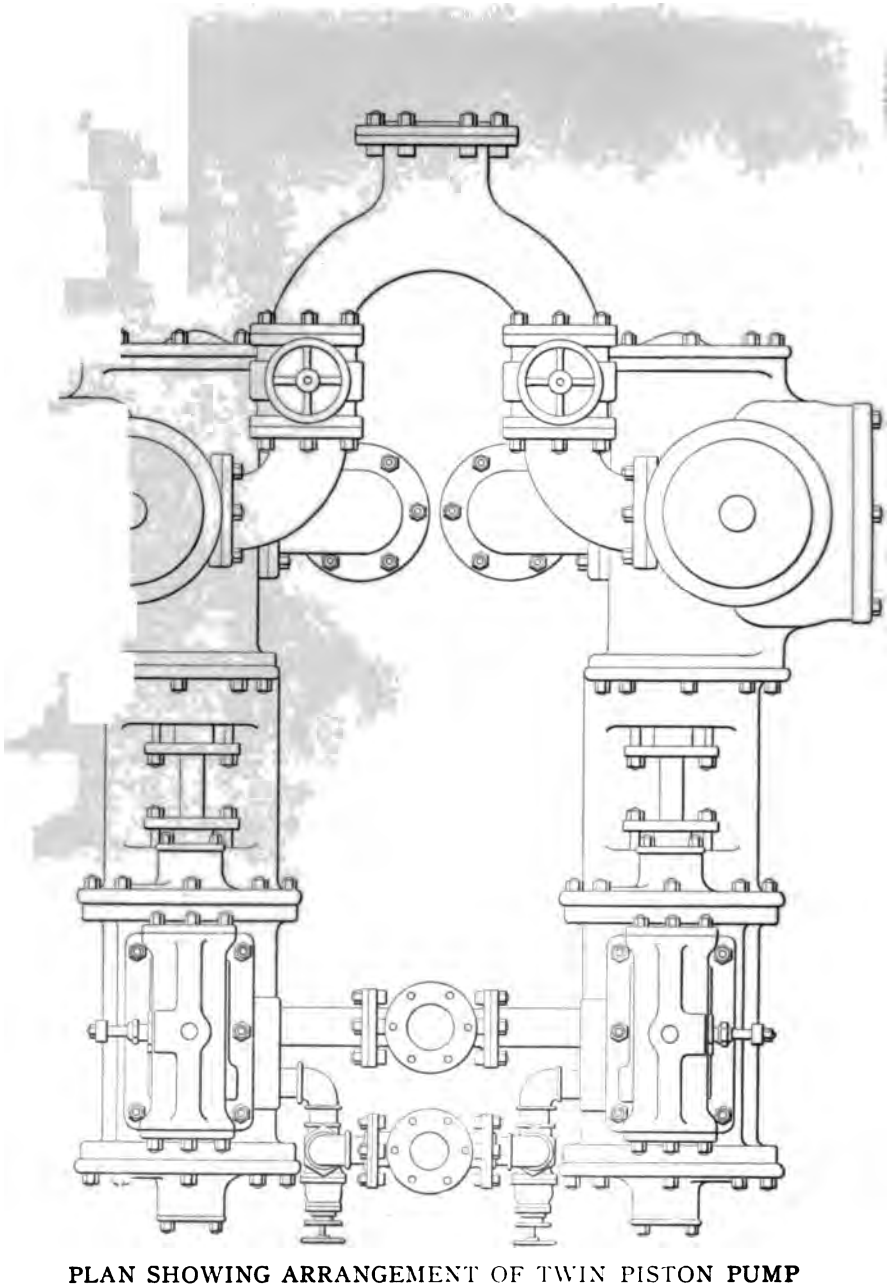
In the designing of our compound pump we have sought to accomplish the following results:

1. To maintain a characteristic feature of the CAMERON pump, viz.: no outside valve gear.
2. To render the pump no more liable to get out of order than a single cylinder pump.
3. To avoid adding to those possessed by the simple pump any element which would tend to detract from its positiveness.
4. By reducing the length of the steam connection between the high and low pressure cylinders to a minimum, to reduce the fall in pressure as much as possible and thus increase the efficiency of the pump.

We have fully succeeded in securing these results. There is no outside valve gear, and the measure adopted to move the valve of the low pressure cylinder involves no additional mechanism whatever, and therefore the pump will not get out of order from that cause. The photographic reproduction illustrates size 10 and 18x10x18. The smaller sizes are made with the high pressure steam cylinder on the end and with iron body instead of steel connecting rods.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining Piston and Piston Rod of Composition	Diameter of High Pressure Steam Cylinder, Inches	Diameter of Low Pressure Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Atacama	.....	.....	7	12	5	13	1.10	100	1	2½	4	3	2350
Ataki	.....	.....	7	12	5½	13	1.33	125	1	2½	4	3½	2350
Atalissa	.....	.....	8	14	6	13	1.59	150	1	3	4	3½	2880
Atarfe	.....	.....	8	14	6½	13	1.87	180	1	3	5	4	3000
Atascosa	.....	.....	9	16	6½	18	2.59	180	1	4	5	4	3700
Atax	.....	.....	7	12	7	13	2.16	200	1	2½	5	4	2400
Atbara	.....	.....	10	18	7	18	3.00	200	1¼	4	5	4	4700
Atcham	.....	.....	9	16	7½	18	3.44	230	1	4	5	5	4400
Ateleta	.....	.....	8	14	8	13	2.83	260	1	3	5	5	3100
Aterno	.....	.....	10	18	8	18	3.90	260	1¼	4	6	5	5200
Ateste	.....	.....	12	22	8	20	4.35	260	1½	5	6	5	6900
Athani	.....	.....	9	16	9	18	4.96	330	1	4	6	5	4300
Athelney	.....	.....	12	22	9½	20	6.13	370	1½	5	6	5	6900
Athens	.....	.....	7	12	10	13	4.42	400	1	2½	6	5	2800
Atherton	.....	.....	10	18	10	18	6.12	400	1¼	4	6	5	5400
Athlone	.....	.....	14	26	10	20	6.80	400	2	5	6	5	8200
Athos	.....	.....	14	26	11	20	8.22	500	2	5	10	8	10000
Atrenza	.....	.....	16	30	11	20	8.22	500	2½	6	10	8	11500
Atkins	.....	.....	8	14	12	20	9.80	600	1	3	10	8	5800
Atlanta	.....	.....	12	22	12	20	9.80	600	1½	5	10	8	9000
Atlean	.....	.....	9	16	13	20	11.49	700	1	4	12	10	8000
Atoka	.....	.....	16	30	13	20	11.49	700	2½	6	12	10	13000
Atorpit	.....	.....	18	30	13	20	11.49	700	3	6	12	10	14000
Atran	.....	.....	10	18	14	20	13.32	800	1¼	4	12	10	9000
Atraula	.....	.....	14	26	14	20	13.32	800	2	5	12	10	11000
Atripollo	.....	.....	18	30	15	20	15.29	920	3	6	12	10	14000
Attanagar	.....	.....	12	22	16	20	17.40	1000	1½	5	12	10	11000
Attica	.....	.....	16	30	16	20	17.40	1000	2½	6	12	10	12500

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcil."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocil."**



PLAN SHOWING ARRANGEMENT OF TWIN PISTON PUMP NON-COMPOUND. Code word, "Twinoncom"

Cameron Twin Piston Pump—Non-Compound
For General Service

For this work we believe we can offer a pump possessing more than usual merit, having features which render it vastly superior to the common duplex pumps, which are ordinarily made of one type and are very faulty in design. While the duplex pumps possess some theoretical advantages, which are not, however, realized in practice, we have not hesitated to guarantee our single pumps of the same proportions to do quite as much work, and which we believe they are capable of doing.

By our arrangement we obtain an equable flow of water in the discharge, which, under heavy pressure particularly, is of the greatest importance; and the economical use of steam is greatly enhanced by that fact, as well as by the well-known features of the CAMERON pump, which tend in the same direction. Moreover, by providing suitable stop and gate valves, each pump may be run separately whenever required, thus permitting the stoppage of one pump for repairs, or other purposes, and only partially diminishing the water supply, as the other may be speeded up.

The twin compound pumps illustrated on pages 46 and 58, also possess characteristics which render them superior to all others on the market, as they retain the CAMERON features of inside valve gear, and are so simple in their design that no more skill is required to run them than a simple pump.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of each Steam Cylinder Inches	Diameter of each Water Cylinder Inches	Stroke of Piston Inches	Capacity per Stroke of each Piston Gallons	Capacity at Ordinary Speed per Minute both Pistons, Gallons	Steam Pipe	Exhaust Pipe	Two Suction Pipes Each	Discharge Pipe	Weight
Aibling	.....	.....	7	3½	12	.5	100	1½	2	3	3½	1740
Aidab	.....	.....	7	5	13	1.10	200	1½	2	4	4	2335
Aidenat	.....	.....	8	4	12	.65	130	1½	2½	3	3½	1830
Aidinjik	.....	.....	8	5	13	1.10	200	1½	2½	4	4	2420
Aidlingen	.....	.....	10	5	13	1.10	200	2	3	4	4	2840
Aidone	.....	.....	10	6	13	1.58	300	2	3	4	5	2970
Aidos	.....	.....	12	7	13	2.16	400	2½	3½	5	6	4060
Aigash	.....	.....	14	8	13	2.83	522	3	4	5	6	5350
Aignan	.....	.....	14	9	18	4.96	660	3	4	6	6	6550
Ailano	.....	.....	16	10½	18	6.75	900	3½	5	8	8	10050
Aintab	.....	.....	18	12	20	9.80	1174	4	5	10	10	13220

***If pump with iron water cylinder and steel piston rod is desired, add the word "Ironcil."**
If pump with water cylinder lining, piston and piston rod of composition is desired, add the word "Compocil."

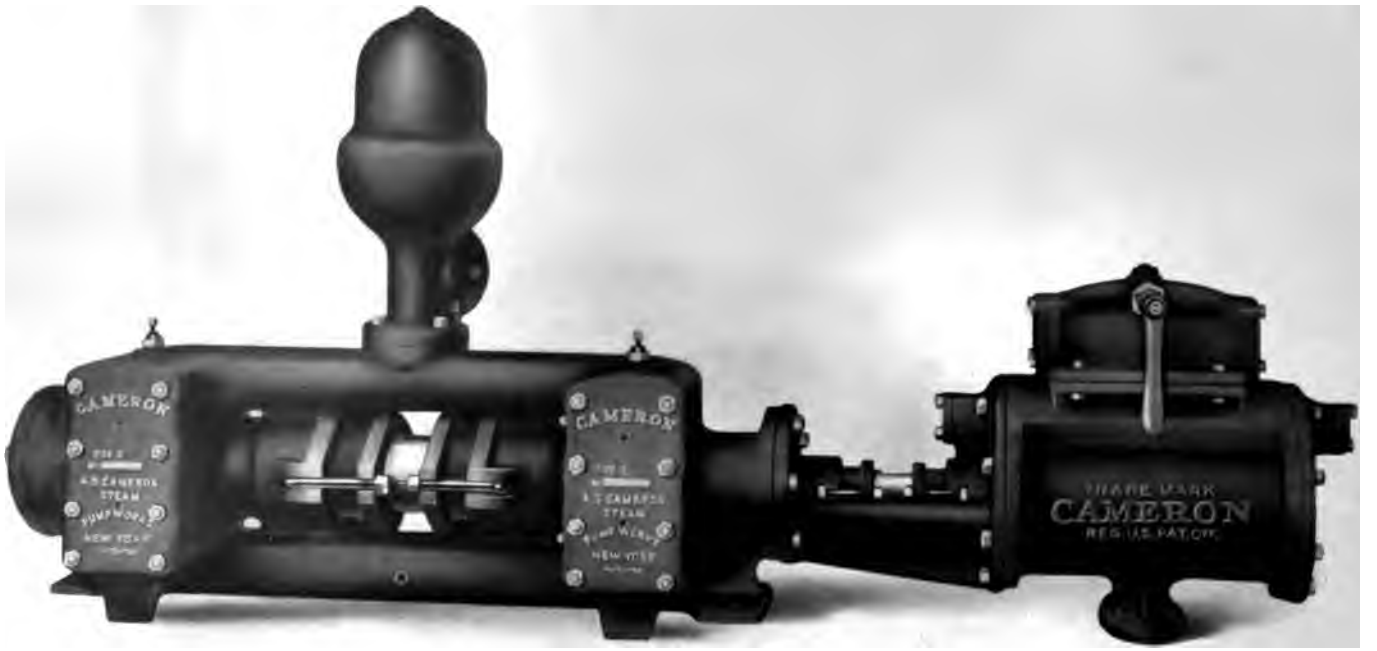
COMPOUND TWIN PISTON PUMP. Code word, "Regtwincom"

Cameron Compound Twin Piston Pump

Our Compound Twin Pump is one which we offer to the public as possessing features which render it the most efficient of direct-acting pumps, having the characteristics of the compound and twin types already described on pages 43 and 45, and which are here found in combination. The efficiency of the machine is greatly enhanced by the fact that ordinarily during the period when the steam is expanding in one of the pair to a low tension, its companion has a high mean pressure, which contributes toward a more equable flow of the water from the discharge than would be the case in a pump where one side waited until the other had nearly reached the end of its stroke before reversal. This type is well suited for water works and other plants where economy is a requisite, and the situation does not warrant the installation of a large, heavy and relatively expensive pumping engine having Corliss valves, heavy fly-wheel, and other attachments of machines of that character. The photographic reproduction illustrates size 18 and 30x12x20. We also illustrate and describe the Compound Twin Outside Center Packed, Pipe Plunger Pattern, on pages 58-59 and 61.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of High Pressure Steam Cylinder, Inches	Diameter of Low Pressure Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Two Suction Pipes, Each	Discharge Pipe	Weight
Aubel	.....	.....	7	12	5	13	2.20	200	1½	3½	4	4	4716
Aubin	.....	.....	8	14	6	13	3.18	300	1½	4	4	5	5772
Auchel	.....	.....	7	12	7	13	4.32	400	1½	3½	5	6	4916
Aucilla	.....	.....	10	18	7	18	6.00	400	2	5	5	6	9480
Audubon	.....	.....	8	14	8	13	5.86	520	1½	4	5	6	6272
Auersberg	.....	.....	10	18	8	18	7.80	520	2	5	6	6	10580
Augusta	.....	.....	12	22	8	20	8.70	520	2½	6	6	6	13800
Aulert	.....	.....	10	18	9	18	9.92	660	2	5	6	6	10500
Aurask	.....	.....	12	22	9	20	11.00	660	2½	6	6	6	14000
Auriac	.....	.....	10	18	10	18	12.24	800	2	5	6	8	10880
Aurozon	.....	.....	12	22	10	20	13.60	800	2½	6	6	8	14200
Ausona	.....	.....	14	26	11	20	16.44	1000	3	6	8	10	20600
Austin	.....	.....	16	30	11	20	16.44	1000	3½	8	8	10	23000
Autage	.....	.....	12	22	12	20	19.60	1200	2½	6	10	10	19000
Autrip	.....	.....	14	26	12	20	19.60	1200	3	6	10	10	21000
Avacher	.....	.....	16	30	12	20	19.60	1200	3½	8	10	10	24000
Avallope	.....	.....	14	26	13	20	22.98	1400	3	6	12	10	23000
Averde	.....	.....	18	30	13	20	22.98	1400	4	8	12	10	25000
Avento	.....	.....	12	22	14	20	26.64	1600	2½	6	12	12	21000
Avezzano	.....	.....	14	26	14	20	26.64	1600	3	6	12	12	23000
Avigron	.....	.....	18	30	14	20	26.64	1600	4	8	12	12	25000
Avile	.....	.....	14	26	16	20	34.80	2000	3	6	12	14	25000
Avollon	.....	.....	18	30	16	20	34.80	2000	4	8	12	14	27000

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcll."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocll."**



OUTSIDE PACKED PLUNGER PUMP—REGULAR PATTERN. Code word, "Regplunger"

Cameron Outside Packed Plunger Pump—Regular Pattern

This pump is especially adapted for station duty in mines, and is far more durable than a piston pump for handling gritty water.

There are no wearing parts in the water end except the packing in the stuffing-boxes, which can be instantly tightened up from the outside. Since the plunger works in loose sleeves, the pump barrel cannot be cut or worn by grit or sand, and the stuffing-boxes are placed in the center, so that there is no tendency for the plunger to sag. It is more compact than any other make of plunger pump, and has no outside rods or crossheads. It is also adapted for feeding boilers under heavy pressure. The photographic reproduction illustrates size 12x6x18.

Code Word*	Size	Price, with Iron Plunger and Steel Piston Rod	Price, with Composition Plunger and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Capacity at Ordinary Speed per Minute Gallons	Boilers in Horse Power they will supply at Moderate Speed based on 30 lbs. of Water per Horse Power per hour	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Floor Space Inches	Weight
Baal	A	$125	$150	4	2	6	12	60	¾	1½	1¼	1	53 x 10	283
Babahan	B	220	250	6	3	7	28	140	¾	1	2	1½	59 x 13	551
Babek	B-B	270	300	7	3½	7	38	190	¾	1	2	1½	60 x 15	600
Babia		325	375	7	3½	12	50	325	1	1½	3	2½	82 x 18	1200
Bacalar	C	375	425	8	4	12	65	425	1	1½	3	2½	82 x 18	1291
Bachmut	D	475	550	10	5	13	100	670	1¼	2	4	3	91 x 23	1937
Backbone		515	600	12	5	13	100	670	1½	2½	4	3	91 x 25	2173
Backrit		500	575	8	6	13	150	1000	1	1½	4	3½	94 x 23	1960
Backset		525	600	10	6	13	150	1000	1¼	2	4	3½	96 x 24	2150
Bacoli	E	625	750	12	6	18	150	1000	1½	2½	5	4	114 x 25	2995
Bacup		700	825	14	6	18	150	1000	2	3	5	4	126 x 27	3517
Badajos		750	925	16	6	18	150	1000	2½	4	5	4	130 x 28	4000
Badoor		585	650	10	7	13	200	1325	1¼	2	5	4	99 x 26	2575
Baerum	E-E	625	700	12	7	13	200	1325	1½	2½	5	4	99 x 27	2735
Bafra		650	750	12	7	18	200	1325	1½	2½	5	4	114 x 27	2970
Baganga		675	775	14	7	13	200	1325	2	3	5	4	103 x 27	3135
Bagnasco		700	800	14	7	18	200	1325	2	3	5	4	126 x 28	3505
Bagni		750	900	16	7	18	200	1325	2½	4	5	4	130 x 28	3820
Bagnorea		800	1000	18	7	18	200	1325	3	4	5	4	133 x 33	4775
Bahama	F	785	915	14	8	18	261	1725	2	3	6	5	126 x 29	4408
Bahari		850	1000	16	8	18	261	1725	2½	4	6	5	130 x 30	4880
Baikal		825	975	14	9	18	330	2200	2	3	6	5	126 x 29	4500
Bakel		875	1075	16	9	18	330	2200	2½	4	6	5	130 x 32	4850
Bakhoba		950	1175	18	9	20	330	2200	3	4	6	5	137 x 33	5750

*If pump with iron plunger and steel piston rod is desired, add the word **"Irplunrod."** If pump with composition plunger and piston rod is desired, add the word **"Complunrod."**

COMPOUND OUTSIDE PACKED PLUNGER PUMP—REGULAR PATTERN

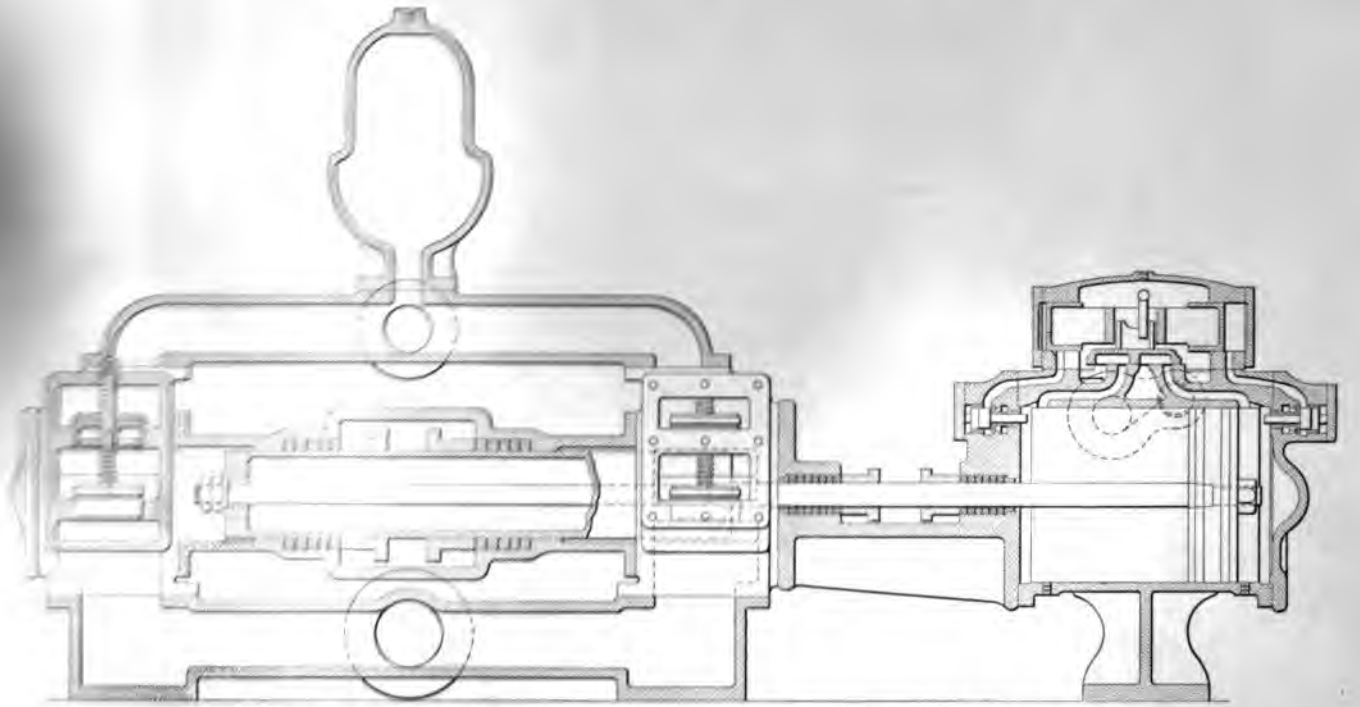
Code word, "Regcomplun"

Cameron Compound Outside Packed Plunger Pump—Regular Pattern

On page 49 we explain the principal features of the CAMERON Plunger Pump, regular pattern, and on page 41 we have treated of the Compound Steam end. The photographic reproduction illustrates size 18 and 30x10x20, and is simply a combination of both, and therefore needs no further explanation. The smaller sizes are made with the high pressure steam cylinder on the end.

Code Word*	Price, with Iron Plunger and Steel Piston Rod	Price, with Composition Plunger and Piston Rod	Diameter High Pressure Steam Cylinder, Inches	Diameter Low Pressure Steam Cylinder, Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Gallons Discharged per Stroke	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe Inches	Exhaust Pipe Inches	Suction Pipe Inches	Discharge Pipe, Inches	Weight
Nab	.....	.....	5	8	3½	12	.50	50	¾	1½	3	2½	1540
Naafar	.....	.....	6	10	3½	13	.54	50	¾	2	3	2½	1840
Naast	.....	.....	5	8	4	12	.65	65	¾	1½	3	2½	1590
Nabalon	.....	.....	6	10	4	13	.70	65	¾	2	3	2½	1850
Nabboard	.....	.....	7	12	4	13	.70	65	1	2½	3	2½	2165
Nabburg	.....	.....	6	10	5	13	1.10	100	¾	2	4	3	2200
Nabha	.....	.....	7	12	5	13	1.10	100	1	2½	4	3	2590
Nablight	.....	.....	8	14	5	18	1.53	100	1	3	4	3	3220
Nabon	.....	.....	9	16	5	18	1.53	100	1	4	4	3	3920
Nachar	.....	.....	8	14	6	18	2.20	150	1	3	5	4	4065
Naches	.....	.....	9	16	6	18	2.20	150	1	4	5	4	4750
Nachod	.....	.....	10	18	6	18	2.20	150	1¼	4	5	4	5040
Nachusa	.....	.....	9	16	7	18	3.00	200	1	4	5	4	4570
Nacimento	.....	.....	10	18	7	18	3.00	200	1¼	4	5	4	5615
Nackel	.....	.....	12	22	7	20	3.33	200	1½	5	5	4	6570
Nackiloo	.....	.....	10	18	8	18	3.92	260	1¼	4	6	5	6840
Nacundi	.....	.....	12	22	8	20	4.35	260	1½	5	6	5	7600
Nadaun	.....	.....	14	26	8	20	4.35	260	2	5	6	5	8750
Nadeau	.....	.....	12	22	9	20	5.51	330	1½	5	6	5	7800
Nadinal	.....	.....	14	26	9	20	5.51	330	2	5	6	5	8100
Nadiva	.....	.....	16	30	9	20	5.51	330	2½	6	6	5	9900
Nadudvar	.....	.....	12	22	10	20	6.8	400	1½	5	8	6	8600
Nadworna	.....	.....	14	26	10	20	6.8	400	2	5	8	6	9600
Naga	.....	.....	16	30	10	20	6.8	400	2½	6	8	6	10650
Nagal	.....	.....	18	30	10	20	6.8	400	3	6	8	6	12525

*If pump with iron plunger and steel piston rod is desired, add the word **"Irplunrod."** If pump with composition plunger and piston rod is desired, add the word **"Complunrod."**

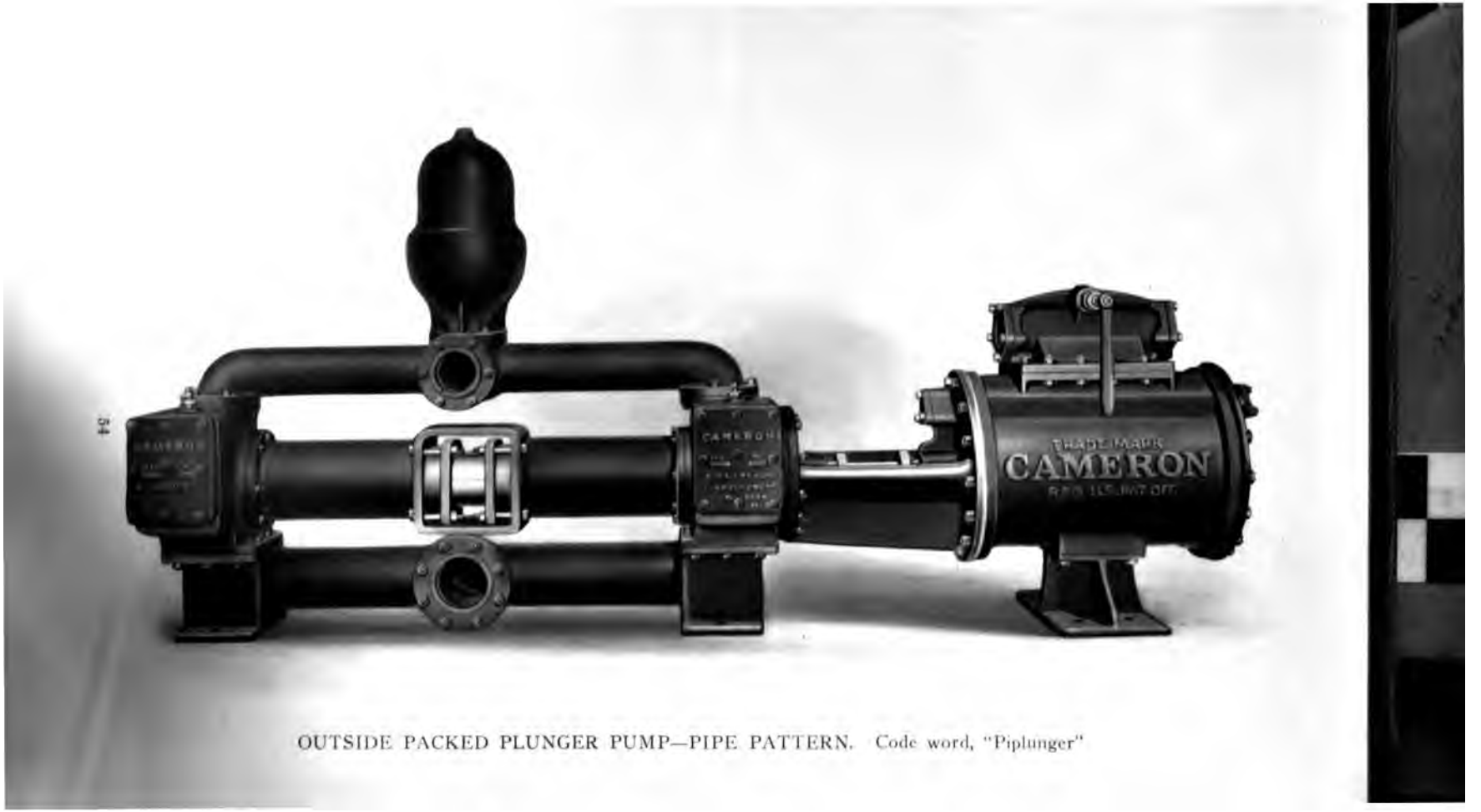


SECTIONAL VIEW OUTSIDE PACKED PLUNGER PUMP—PIPE PATTERN

Cameron Outside Packed Plunger Pump

Pipe Pattern

ALL that we have said of our pumps as to their simplicity, durability and absence of outside valve gear, gains double force when mining work is considered. The drawing on the opposite page shows a longitudinal sectional view of our Pipe Pattern Outside Packed Plunger Pump, which we believe to be the best yet designed for working under the most severe conditions and where the water contains sand or grit or is strongly impregnated with acids. In this connection we wish to say that no iron can indefinitely resist the worst kind of acid water. But, as solid composition water ends in pumps of large capacity are very costly, we have designed this pump, which is practically built in sections, so that if any part is finally eaten away, it can be replaced at a minimum of expense, and the whole water end is not ruined. Our latest patterns embody all the improvements that years of experience in mining work have suggested. There are no rods, arms or working parts exposed to rust or damage either from carelessness or accident. The plunger, being supported in packing boxes near the center, cannot sag or get out of line at the ends of the stroke. Although the pump is so compact, all parts are readily and easily accessible, while the water end is made exceptionally heavy and with large valve area.



OUTSIDE PACKED PLUNGER PUMP—PIPE PATTERN. Code word, "Piplunger"

neron Outside Packed Plunger Pump — Pipe Pattern

	Price with Iron Plunger and Steel Piston Rod	Price, with Composition Plunger and Piston Rod	Diameter of Steam Cylinder Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity per minute at ordinary Speed Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
[illegible]con	.....	.....	14	8	18	3.9	261	2	3	6	5	5850
[illegible]uncull	.....	.....	16	8	18	3.9	261	2½	4	6	5	6200
Beale	.....	.....	18	8	20	4.35	261	3	4	6	5	6700
Beaman	.....	.....	18	8	33	7.18	290	3	4	6	5	7226
Bearden	.....	.....	20	8	20	4.35	261	4	5	6	5	7800
Beason	.....	.....	20	8	33	7.18	290	4	5	6	5	8551
Beatie	.....	.....	14	9	18	4.96	330	2	3	8	6	7200
Beauce	.....	.....	16	9	18	4.96	330	2½	4	8	6	7550
Beauford	.....	.....	18	9	20	5.50	330	3	4	8	6	8000
Beauport	.....	.....	14	9	33	9.08	350	2	3	8	6	7807
Beauval	.....	.....	16	9	33	9.08	350	2½	4	8	6	8157
Beauzac	.....	.....	18	9	33	9.08	350	3	4	8	6	8704
Bebehan	.....	.....	20	9	33	9.08	350	4	5	8	6	10029
Beccles	.....	.....	22	9	33	9.08	350	4	5	8	6	10636
Bechin	.....	.....	16	10½	20	7.5	450	2½	4	10	8	9070
Beckum	.....	.....	18	10½	20	7.5	450	3	4	10	8	9416
Bedale	.....	.....	20	10½	20	7.5	450	4	5	10	8	10516
Bedeque	.....	.....	22	10½	20	7.5	450	4	5	10	8	10746
Bedja	.....	.....	24	10½	20	7.5	450	4	5	10	8	11266
Bedonia	.....	.....	16	10½	33	12.37	500	2½	4	10	8	9814
Bedretto	.....	.....	18	10½	33	12.37	500	3	4	10	8	10144
Beeder	.....	.....	20	10½	33	12.37	500	4	5	10	8	11444
Beek	.....	.....	22	10½	33	12.37	500	4	5	10	8	12044
Beeranah	.....	.....	24	10½	33	12.37	500	4	5	10	8	13044
Beernem	.....	.....	18	12	20	9.8	587	3	4	10	8	12100
Beersheba	.....	.....	20	12	20	9.8	587	4	5	10	8	13400
Beeskow	.....	.....	22	12	20	9.8	587	4	5	10	8	14000
Beetgum	.....	.....	24	12	20	9.8	587	4	5	10	8	14520
Behrend	.....	.....	18	12	36	17.6	660	3	4	10	8	14800
Beira	.....	.....	20	12	36	17.6	660	4	5	10	8	16120
Beith	.....	.....	22	12	36	17.6	660	4	5	10	8	16400
Beja	.....	.....	24	12	36	17.6	660	4	5	10	8	17000
Bela	.....	.....	26	12	36	17.6	660	4	5	10	8	18100
Belaun	.....	.....	28	12	36	17.6	660	5	6	10	8	18390
Belbeys	.....	.....	30	12	36	17.6	660	5	6	10	8	18712
Belchite	.....	.....	32	12	36	17.6	660	5	6	10	8	19712
Belem	.....	.....	22	14	20	13.32	800	4	5	12	10	15500
Belitz	.....	.....	24	14	20	13.32	800	4	5	12	10	16000
Belturbet	.....	.....	24	14	36	24.0	900	4	5	12	10	18980
Belvedere	.....	.....	26	14	36	24.0	900	4	5	12	10	20100
Belzig	.....	.....	28	14	36	24.0	900	5	6	12	10	20390
Benaja	.....	.....	30	14	36	24.0	900	5	6	12	10	20700
Benares	.....	.....	32	14	36	24.0	900	5	6	12	10	21000
Benest	.....	.....	28	16	36	31.32	1180	5	6	12	10	21300
Benfeld	.....	.....	30	16	36	31.32	1180	5	6	12	10	21700
Bengazi	.....	.....	32	16	36	31.32	1180	5	6	12	10	22000

*If pump with iron plunger and steel piston rod is desired, add the word **"Irplunrod."** If pump with composition plunger and piston rod is desired, add the word **"Complunrod."**

COMPOUND OUTSIDE PACKED PLUNGER PUMP—PIPE PATTTERN

Code word, "Compiplun"

Cameron Compound Outside Packed Plunger Pump—Pipe Pattern

The photographic reproduction illustrates size 14 and 26x8x33, and shows a combination of the compound steam end and the outside center-packed, plunger water-end of the pipe-pattern. It would be difficult to conceive of a pump better adapted for heavy and continuous work than this, especially if the water is more or less gritty and not too acidulous. The compound steam end gives a measure of economy in steam consumption, and the symmetrical form of the parts, which are also made extra thick, the large and direct passages and liberal valve area, as well as the sectional construction, contribute to make this pump of such a character that it will give the maximum duty with a minimum of cost for repairs. It is competent to do more work for the amount of power exerted than almost any other type: for it is a fact, that in a majority of pumps much power is absorbed in overcoming frictional resistance due to crooked, tortuous and contracted passages, and the greatest amount of work can be obtained from that pump which avoids, to the greatest extent, the above fault. Moreover, the wear or abrasion of the surface exposed to the water is very greatly affected by the shape of the passages and their sizes; the latter particularly, as the smaller the passages, the greater the velocity of the flow of water which when carrying grit or sand with it will have a tendency to scour and wear away the surface of the metal. Now, if in conjunction with this scouring effect we have the action of acid water to corrode the metal, it will readily be seen that the result must necessarily prove disastrous eventually. These faults are all largely avoided in the design of this pump.

Code Word*	Price, with Iron Plunger and Steel Piston Rod	Price, with Composition Plunger and Piston Rod	Diameter of High Pressure Steam Cylinder, Inches	Diameter of Low Pressure Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Attlabaf	.....	.....	8	14	8	18	3.90	260	1	3	6	5	6400
Attlabest	.....	.....	10	18	8	20	4.35	260	1¼	4	6	5	7700
Attlabid	.....	.....	12	22	8	20	4.35	260	1½	5	6	5	9200
Attlabome	.....	.....	10	18	9	20	4.96	330	1	4	8	6	8350
Attlabun	.....	.....	12	22	9	20	5.50	330	1½	5	8	6	10530
Attlabyer	.....	.....	10	18	10	20	6.80	400	1¼	4	10	8	10420
Attlebang	.....	.....	12	22	10	20	6.80	400	1½	5	10	8	11950
Attlecen	.....	.....	14	26	10	20	6.80	400	2	5	10	8	13500
Attleduff	.....	.....	12	22	10½	20	7.50	450	1½	5	10	8	11950
Attlefill	.....	.....	14	26	10½	20	7.50	450	2	5	10	8	13500
Attlegos	.....	.....	12	22	12	20	9.80	600	1½	5	10	8	15200
Attlehym	.....	.....	14	26	12	20	9.80	600	2	5	10	8	16720
Attlejug	.....	.....	16	30	12	20	9.80	600	2½	6	10	8	17620
Attlekite	.....	.....	14	26	14	20	13.32	800	2	5	12	10	18200
Attlemur	.....	.....	16	30	14	20	13.32	800	2½	6	12	10	19100
Attlenod	.....	.....	18	30	14	20	13.32	800	3	6	12	10	19540
Attlepan	.....	.....	16	30	16	20	17.40	1050	2½	6	12	10	19700
Attlequt	.....	.....	18	30	16	20	17.40	1050	3	6	12	10	20140

*If pump with iron plunger and steel piston rod is desired, add the word **"Irplunrod."** If pump with composition plunger and piston rod is desired, add the word **"Complunrod."**

COMPOUND TWIN OUTSIDE PACKED PLUNGER PUMP--PIPE PATTERN

Code word, "Twinpiplun"

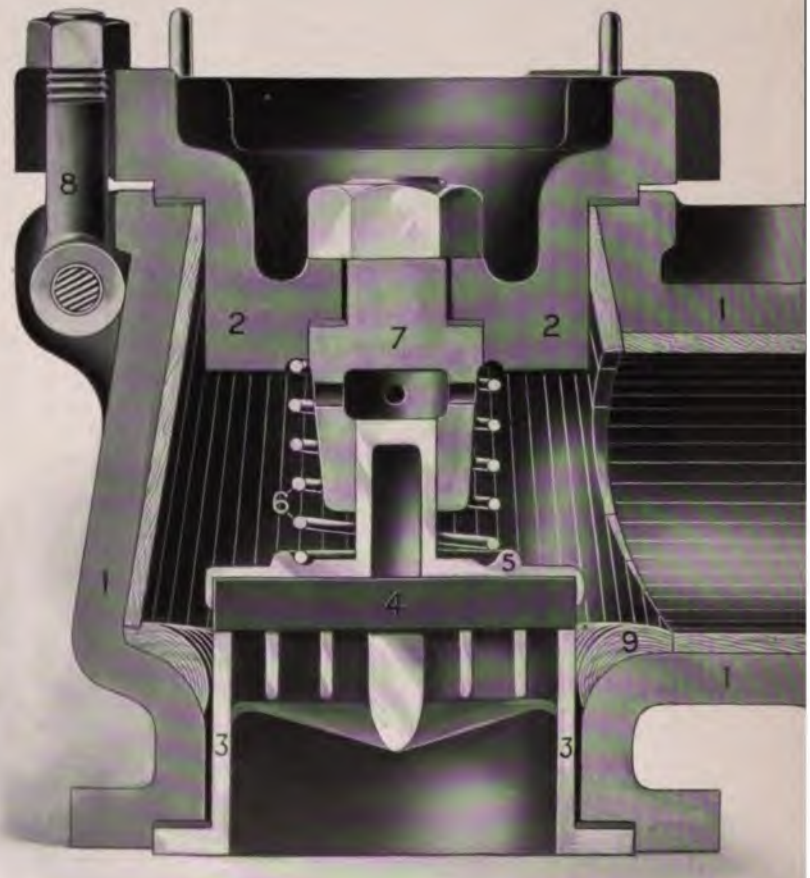
Cameron Compound Twin Outside Packed Plunger Pump—Pipe Pattern

Some of the general characteristics of the CAMERON Compound Twin Pump are referred to on pages 45 and 47 which, however, describe this type with piston water ends.

The photographic reproduction illustrates size 18 and 30x14x20, with outside center-packed plunger, pipe pattern water ends. To avoid repetition, therefore, we would state that the steam ends are exactly like those described and illustrated, page 47, and the water ends are similar to those illustrated and described on pages 53 and 57. This combination constitutes a twin pump, which for handling gritty water cannot be surpassed. Below are listed a number of sizes, but various other combinations may be made, and compound pumps should have their steam ends properly proportioned for the work they are intended to do.

Code Word*	Price, with Iron Plunger and Steel Piston Rod	Price, with Composition Plunger and Piston Rod	Diameter of High Pressure Steam Cylinder, Inches	Diameter of Low Pressure Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity per Stroke Gallons	Capacity per minute at Ordinary Speed Gallons	Steam Pipe	Exhaust Pipe	Two Suction Pipes, Each	Discharge Pipe	Weight
Awaco	.....	.....	8	14	8	18	7.80	520	1½	4	6	6	13600
Awaker	.....	.....	10	18	8	20	8.70	520	2	5	6	6	16200
Awalt	.....	.....	12	22	8	20	8.70	520	2½	6	6	6	19200
Awany	.....	.....	10	18	9	20	9.92	660	2	5	8	8	17500
Awarm	.....	.....	12	22	9	20	11.00	660	2½	6	8	8	21860
Away	.....	.....	10	18	10	20	13.60	800	2	5	10	10	21830
Awilna	.....	.....	12	22	10	20	13.60	800	2½	6	10	10	24890
Awitton	.....	.....	14	26	10	20	13.60	800	3	6	10	10	28000
Awinis	.....	.....	12	22	10½	20	15.00	900	2½	6	10	10	24890
Awingo	.....	.....	14	26	10½	20	15.00	900	3	6	10	10	28000
Awiota	.....	.....	12	22	12	20	19.60	1174	2½	6	10	12	31600
Awirt	.....	.....	14	26	12	20	19.60	1174	3	6	10	12	34640
Awogus	.....	.....	16	30	12	20	19.60	1174	3½	8	10	12	36440
Awoka	.....	.....	14	26	14	20	26.64	1600	3	6	12	12	37600
Awon	.....	.....	16	30	14	20	26.64	1600	3½	8	12	12	39400
Awope	.....	.....	18	30	14	20	26.64	1600	4	8	12	12	43100
Awoppo	.....	.....	16	30	16	20	34.80	2360	3½	8	12	14	40600
Awray	.....	.....	18	30	16	20	34.80	2360	4	8	12	14	41480

*If pump with iron plunger and steel piston rod is desired, add the word **"Irplunrod."** If pump with composition plunger and piston rod is desired, add the word **"Complunrod."**



SECTIONAL VIEW OF POT VALVE

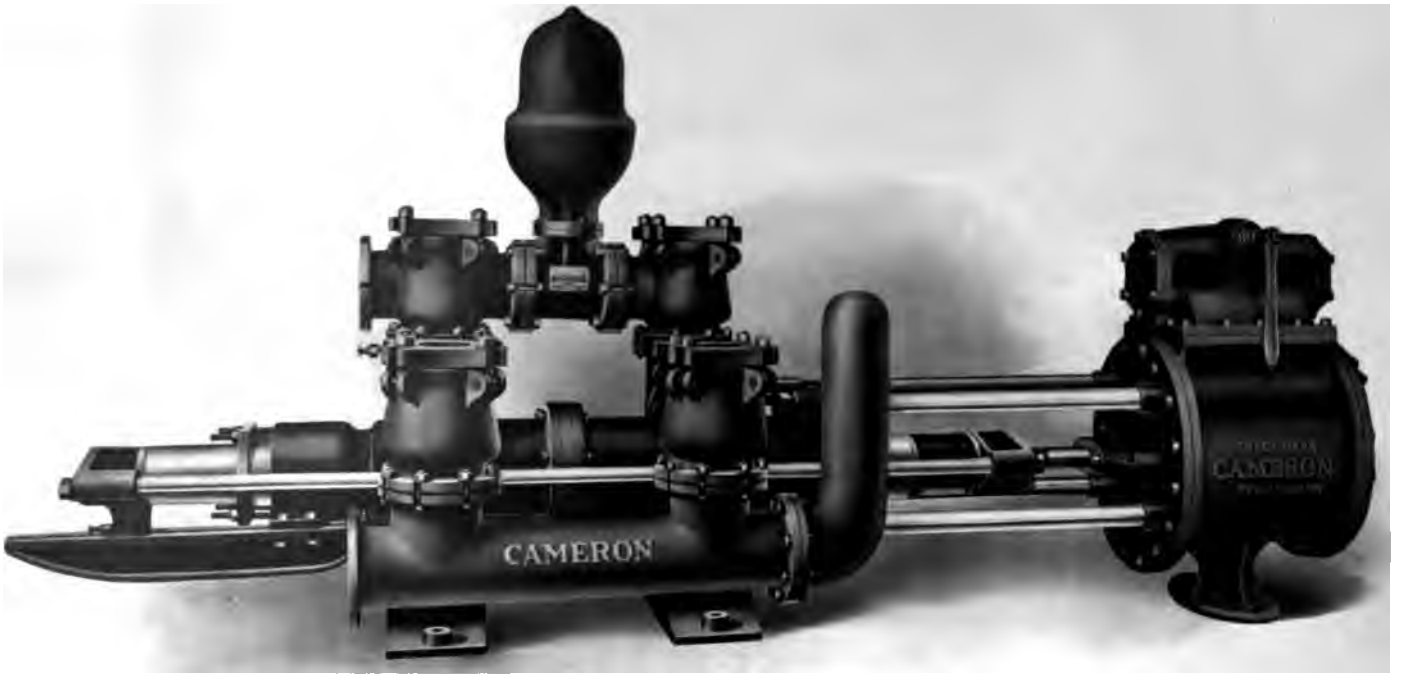
Cameron Outside End Packed Plunger Pump—

Pot-Valve Pattern

WHERE mine water is strongly impregnated with sulphuric and other acids or salts, which are destructive to unprotected cast iron, we can offer a pump having a pot-valve pattern water cylinder. This consists of working barrels and connections, all having cylindrical sections and the valves are enclosed in separate chambers styled "Pots." This construction gives large direct passages and ample area both around and through the valve seats, which are important factors and result greatly in favor of the longevity of the pump.

The illustration on the opposite page shows the interior arrangement of one of these valve pots or chambers. The valve chamber 1 and cover 2 are well proportioned and are cast of a special mixture of hard, close-grained iron. These chambers contain single water valves. The valve seat 3 is a substantial acid-resisting bronze casting securely held in place. The valve 4 is a rubber disc and is protected by the heavy bronze guard 5, which also serves as a stem working in the guide 7. A section of the spring is also shown at 6. The use of a large single water valve in each of these chambers instead of groups of smaller valves allows the passage of comparatively large solid bodies, such as pieces of coal and dirt, which may enter with the water and would otherwise clog the valves. The hinge bolts 8 permit of the covers being quickly removed, thus rendering the valves readily accessible when necessary to free them from any foreign substance or remove the valve, guard, spring or guide, and it takes but a short time to lift off the whole pot when the seat needs renewing.

A distinctive feature of water cylinders of this type is the extra thickness of the metal, which permits of a certain amount of corrosion before the metal becomes too thin to withstand the strain due to the head or resistance; and, when so ordered, the whole interior may be wood-lined with sound white pine (See No. 9), which is securely wedged in place and these linings may be replaced when necessary at a minimum cost.



OUTSIDE END PACKED PLUNGER PUMP—POT-VALVE PATTERN

Code word, "Potplunger"

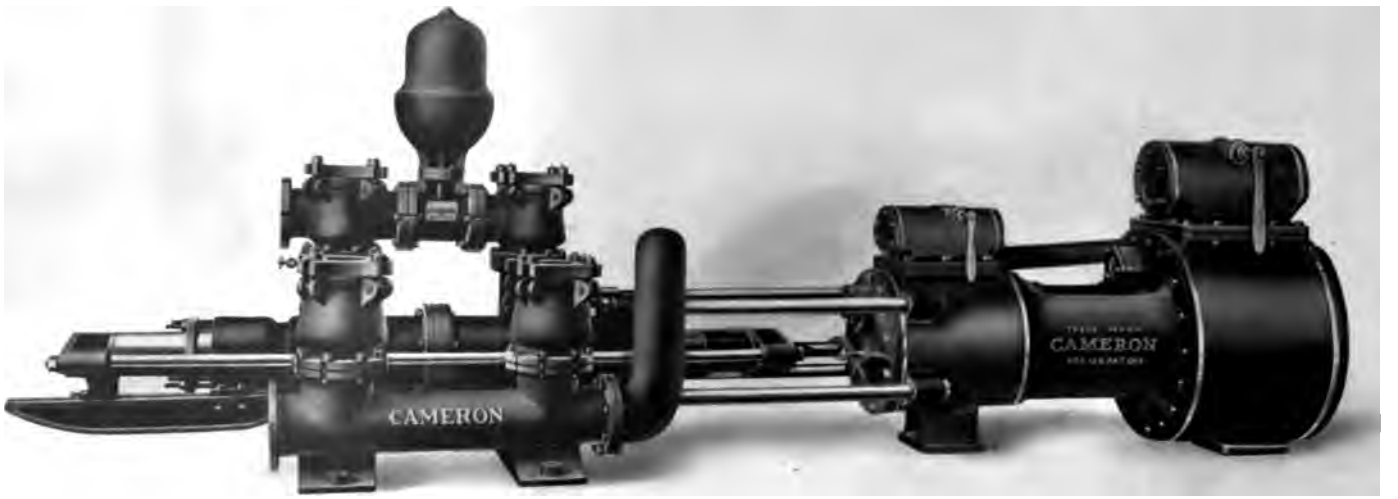
Cameron Outside End Packed Plunger Pump—Pot-Valve Pattern

The photographic reproduction illustrates size 20x9x20. We can furnish pumps of this type of plain iron, or wood-lined, as required, and for any pressures. The meritorious features of this design of water cylinder are explained in the description on the preceding page, 61.

We illustrate and describe the Compound Pot-Valve Pump on pages 64 and 65.

Code Word*	Price, Unlined, with Iron Plunger, Steel Rod and Bronze Throat	Price, Wood Lined, with Iron Plunger, Steel Rod and Bronze Throat	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Bentam	.....	.....	18	9	20	330	3	4	8	6	11485
Bentheim	.....	.....	18	9	33	350	3	4	8	6	12350
Benting	.....	.....	18	9	36	350	3	4	8	6	12460
Bentingan	.....	.....	20	9	20	350	4	5	8	6	12000
Benwood	.....	.....	20	9	33	350	4	5	8	6	13700
Benwoofen	.....	.....	20	9	36	350	4	5	8	6	14300
Benwoofest	.....	.....	22	9	20	330	4	5	8	6	12850
Benzinger	.....	.....	22	9	33	350	4	5	8	6	14290
Benzab	.....	.....	22	9	36	350	4	5	8	6	14500
Benzaback	.....	.....	24	9	20	330	4	5	8	6	13375
Benzabam	.....	.....	24	9	33	350	4	5	8	6	14420
Benzabit	.....	.....	24	9	36	350	4	5	8	6	15800
Bergab	.....	.....	20	10½	20	450	4	5	10	8	15200
Bergomunt	.....	.....	20	10½	36	500	4	5	10	8	18700
Bergomus	.....	.....	22	10½	20	450	4	5	10	8	15450
Bergstaff	.....	.....	22	10½	36	500	4	5	10	8	18875
Bergstagg	.....	.....	24	10½	20	450	4	5	10	8	16000
Bergumat	.....	.....	24	10½	36	500	4	5	10	8	20200
Bernalgat	.....	.....	24	12	20	587	4	5	10	8	19500
Bernan	.....	.....	24	12	36	660	4	5	10	8	24400
Bernast	.....	.....	26	12	20	587	5	6	10	8	20150
Bernburg	.....	.....	26	12	36	660	5	6	10	8	24400
Beronda	.....	.....	28	12	36	660	5	6	10	8	25100
Bersimis	.....	.....	30	12	36	660	5	6	10	8	25560
Berthier	.....	.....	32	12	36	660	5	6	10	8	25900

*If unlined pump with iron plunger and steel rod is desired, add the word **"Irplunrod."** If pump with iron plunger and steel rod and wood lined is desired, add the word **"Woodline."**



COMPOUND OUTSIDE END PACKED PLUNGER PUMP—POT-VALVE PATTERN

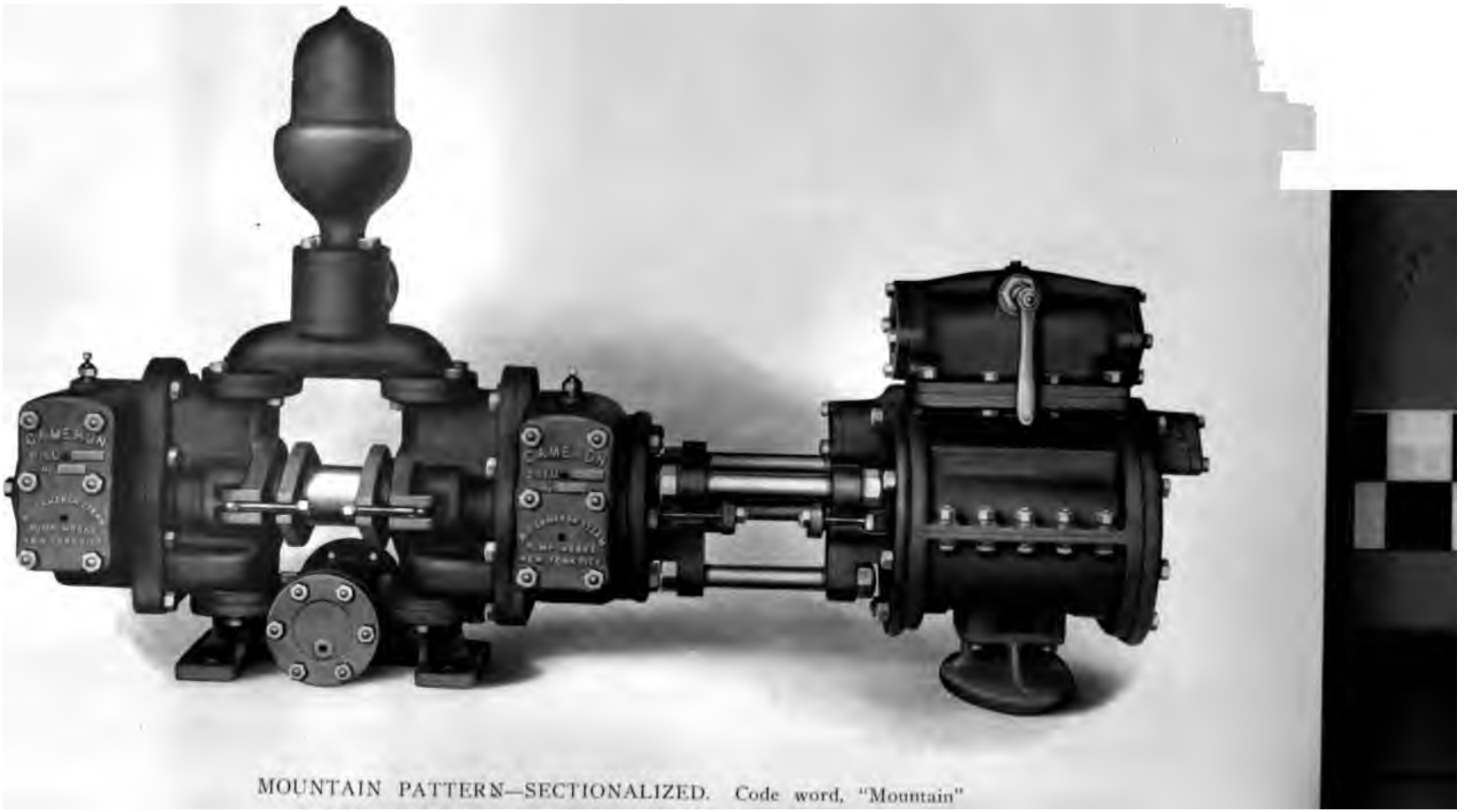
Code word, "Compotplun"

Cameron Compound Outside End Packed Plunger Pump—Pot-Valve Pattern

The photographic reproduction illustrates size 14 and 26x9x20 of our Compound Plunger Pot-Valve Pattern. This design of pump has been adopted in the Coal and Copper fields, where the water is highly acidulous, and when necessary can be arranged as a twin, consisting of two independent pumps connected together in the same manner as our Compound Twin Pipe Pattern illustrated on page 58.

Code Word*	Price, Unlined, with Iron Plunger, Steel Rod and Bronze Throat	Price, Wood Lined, with Iron Plunger, Steel Rod and Bronze Throat	Diameter of High Pressure Steam Cylinder, Inches	Diameter of Low Pressure Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Bevis	.....	.....	12	22	9	20	333	1¼	5	9	8	13800
Bevisto	.....	.....	14	26	9	20	330	2	5	9	8	15525
Bevode	.....	.....	16	30	9	20	330	2½	6	9	8	16185
Bewat	.....	.....	16	30	9	24	333	2½	6	9	8	17730
Bewland	.....	.....	16	30	9	33	350	2½	6	9	8	18800
Bewley	.....	.....	16	30	9	36	350	2½	6	9	8	19260
Bewrence	.....	.....	12	22	10⅛	20	450	1½	5	10	9	16150
Bewsom	.....	.....	14	26	10⅛	20	450	2	5	10	9	18150
Bexan	.....	.....	16	30	10⅛	20	450	2½	6	10	9	18400
Bexaval	.....	.....	16	30	10⅛	24	450	2½	6	10	9	20400
Bexique	.....	.....	16	30	10⅛	33	500	2½	6	10	9	22400
Beyas	.....	.....	16	30	10⅛	36	500	2½	6	10	9	24060
Beyasute	.....	.....	18	30	10⅛	24	450	3	6	10	9	21000
Beyatom	.....	.....	18	30	10⅛	33	500	3	6	10	9	23000
Beyawol	.....	.....	18	30	10⅛	36	500	3	6	10	9	24900
Beyhar	.....	.....	14	26	12	20	587	2	5	12	10	21650
Beynet	.....	.....	14	26	12	36	660	2	5	12	10	26100
Beynold	.....	.....	16	30	12	20	587	2½	6	12	10	23700
Beyros	.....	.....	16	30	12	36	660	2½	6	12	10	28300
Beysoot	.....	.....	18	30	12	20	587	3	6	12	10	24800
Beyware	.....	.....	18	30	12	36	660	3	6	12	10	29090
Bezdan	.....	.....	20	36	12	36	660	4	7	12	10	32440
Bezenda	.....	.....	22	40	12	36	660	4	8	12	10	44160

*If unlined pump with iron plunger and steel rod is desired, add the word **"Irplunrod."** If pump with iron plunger and steel rod and wood lined is desired, add the word **"Woodline."**



MOUNTAIN PATTERN—SECTIONALIZED. Code word, "Mountain"

Cameron Plunger Pump—Mountain Pattern

This is our regular horizontal outside packed plunger pump built in sections for mule-back transportation. It is intended for regions where transportation facilities are crude, and each unit carried is limited to 300 pounds weight. In many of the pumps on this list two pieces weigh 300 pounds, the other pieces being within 150 pounds. The photographic reproduction illustrates sizes 14x6x8.

Code Word*	Price, with Iron Plunger and Steel Piston Rod	Price with Composition Plunger and Piston Rod	Diameter of Steam Cylinder Inches	Diameter of Plunger, Inches	Stroke of Piston Inches	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Biana	.....	.....	8	4	12	65	1	1¼	3	2½	1425
Biasca	.....	.....	9	4	13	65	1	1½	3	2½	1470
Biblis	.....	.....	10	4	13	65	1¼	2	3	2½	2200
Bida	.....	.....	12	4	13	65	1½	2½	3	2½	2370
Biella	.....	.....	14	4	13	65	2	3	3	2½	2860
Bienne	.....	.....	9	5	13	100	1	1½	4	3	2140
Bigorre	.....	.....	10	5	13	100	1¼	2	4	3	2190
Bilin	.....	.....	12	5	13	100	1½	2½	4	3	2380
Binab	.....	.....	14	5	13	100	2	3	4	3	2900
Bingen	.....	.....	9	6	13	150	1	1½	4	3½	2350
Binondo	.....	.....	10	6	13	150	1¼	2	4	3½	2400
Biograd	.....	.....	12	6	13	150	1½	2½	4	3½	2550
Bioul	.....	.....	14	6	13	150	2	3	4	3½	2950
Biron	.....	.....	14	6	18	150	2	3	5	4	3150

*If pump with iron plunger and steel piston rod is desired, add the word **"Irplunrod."** If pump with composition plunger and piston rod is desired, add the word **"Complunrod."** Patented January 23, 1900.

SECTIONAL VIEW OF VERTICAL PLUNGER SINKING PUMP

Cameron Vertical Plunger Sinking Pump

THIS is the most successful sinking pump that has ever been placed on the market. Any steam pump that is to be used in sinking a mine shaft must be strong, certain in operation, capable of handling gritty water, require little attention, and above all be able to stand the roughest kind of usage without sustaining injury.

The CAMERON sinking pump has no outside valve gear, arms or levers to be bent or broken off. It cannot suffer from violent collision with the walls of the mine shaft, and is not likely to receive injury from the explosion of blasts.

Being fitted with our exhaust cut-off, it will run along as fast as steam will drive it with an irregular or intermittent supply of water, or when the water fails entirely, not only without danger of the piston striking the heads, but without injury to the valves.

Unlike other inside valve movements, the CAMERON steam end is not delicate or complicated, but, being simple and reliable, it is especially superior for duty in a mine where the attention of a skilled engineer is not always available.

It takes up less room in the shaft than any other sinking pump, and will work in any position. It is designed and intended to handle gritty water.

It is packed from the outside easily and quickly, the glands being supplied with hinged bolts.

There are no parts exposed to rust, and instances have occurred when this pump has started off and cleared a shaft of water when the pump itself had been buried for weeks under a mass of fallen rock and debris.

We invite your attention to our recently patented priming device with which we equip our vertical sinking pumps. The priming valve used on other makes is open to two objections. By its operation the whole weight of water in the discharge column is precipitated into the suction hose, which, being designed to resist collapse only, is sometimes ruptured by the undue strain. Furthermore, any accumulation of dirt or sediment behind the valve is likely to render it locked and immovable. Our new priming valves entirely remove these objections, and at the same time do not project laterally and cannot be injured or snapped off by blasting or collision with the wall of the mine shaft—thus leaving the CAMERON pump as before, the only sinking pump that is absolutely invulnerable and safe from external injury.

There are now on the market several imitations of the CAMERON Plunger Sinking Pump, more or less resembling it in appearance and variously advertised under fancy names, or even as "CAMERON Pattern" pumps. When you consider the possible consequences of having your pump break down at a critical time and your mine drowned out, perhaps you will prefer the genuine. The CAMERON Sinking Pump can be distinguished from imitations by our patent priming valves and our acorn-shaped air-chamber, through which we now carry the discharge pipe, instead of placing them on opposite sides of the pump as heretofore. Our experience of over forty years has taught us where to place every pound of metal, every steam port—and a few other things of which you get the benefit. If you are mining, we know that you are using the CAMERON type—only be sure that it is a CAMERON.

To All Whom it May Concern

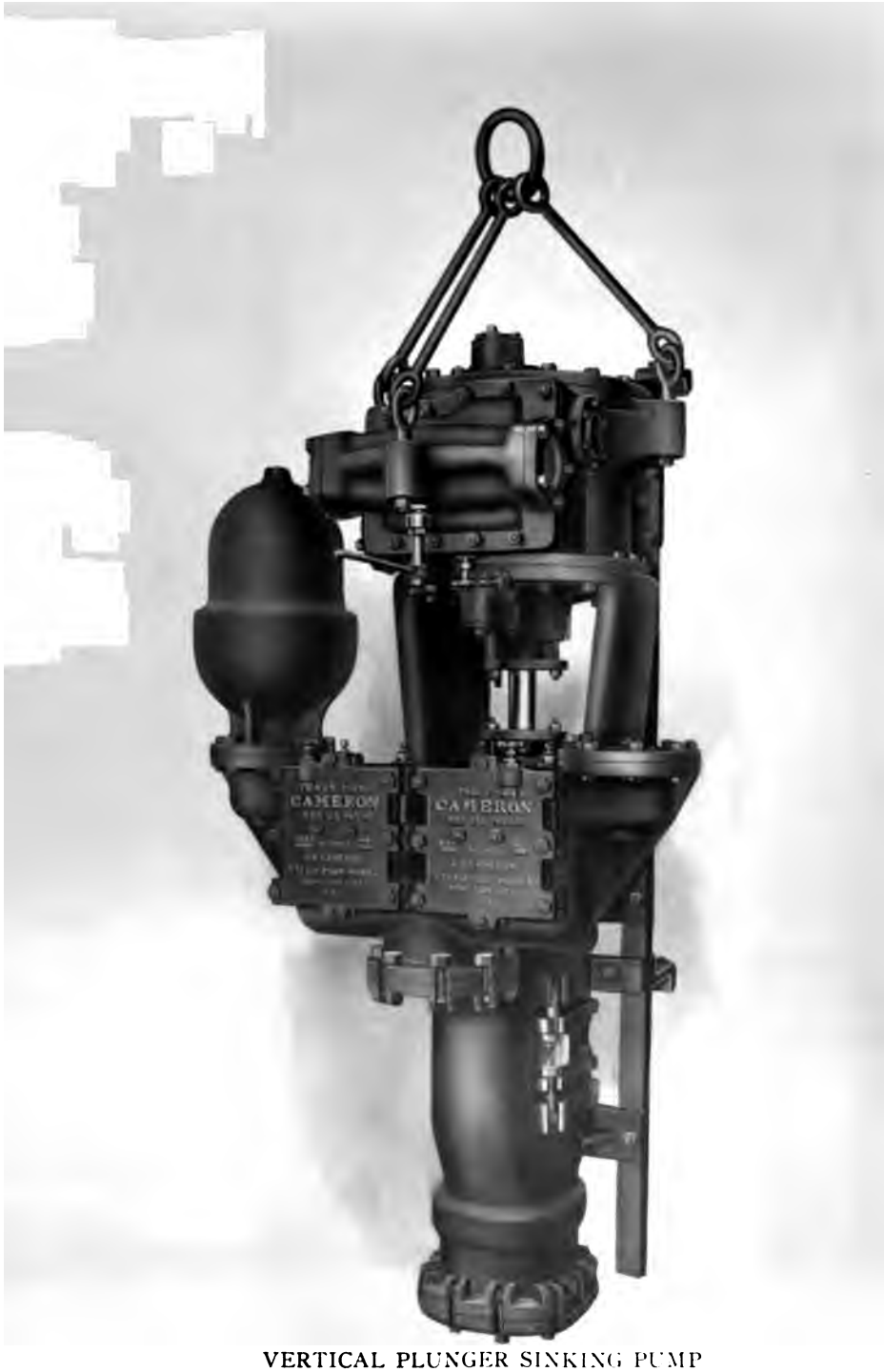
The CAMERON air-chamber and priming valves are protected by patents granted June 27, 1899, and July 18, 1899. All infringements will be promptly dealt with.

Cameron Vertical Plunger Sinking Pump

The photographic reproduction illustrates No. 9, size 12x7x13. In addition to the list of this type contained below, we illustrate our larger sizes on the following pages, 72 and 73. The new features incorporated in this type, as shown in the sectional view on page 68, also in accompanying illustration on the opposite page, are worthy of your consideration.

The distinctive features which tend to enhance the value and add to the utility, are the sand pockets above the single stuffing-box, the stuffing-box through which the plunger moves, hinge bolts for suction, and bottom cover and bonnets of nearly all sizes, our combined acorn-shaped air-chamber and discharge, connection, and our priming device. All these features are subjects of recent patents.

Code Word	Size Number	Price, with Iron Plunger and Steel Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space occupied in Shaft Inches	Weight
Cabaca	5	$350	7	3½	12	.05	50	1	1½	2½	2	24 x 24	1410
Cabanes	6	400	8	4	12	.65	65	1	1½	3	2½	25 x 25	1435
Cabazon	7	500	10	5	13	1.10	100	1¼	2	4	3	31 x 30	2285
Cabellio	..	575	12	5	13	1.10	100	1½	2½	4	3	32 x 33	2620
Cabira	8	525	10	6	13	1.58	150	1¼	2	4	3½	31 x 31	2290
Cabra	9a	575	12	6	13	1.58	150	1½	2½	4	3½	32 x 33	2545
Cachias	..	675	14	6	13	1.58	150	2	3	4	3½	40 x 35	3600
Cadalen	9	625	12	7	13	2.16	200	1½	2½	5	4	34 x 33	3400
Cadenet	9b	675	14	7	13	2.16	200	2	3	5	4	40 x 35	3850
Cadillac	..	750	15	7	13	2.63	200	2½	4	5	4	42 x 40	4650
Cadome	..	850	18	7	16	2.63	200	3	4	5	4	42 x 45	5000
Cadotte	10	725	14	8	13	2.83	261	2	3	5	5	40 x 38	4150
Caffa	11	800	16	8	16	3.48	261	2	4	5	5	42 x 40	4750
Cagli	..	900	16	9	16	4.40	330	2½	4	6	5	42 x 45	5220
Caguan	12	1000	18	9	16	4.40	330	3	4	6	5	42 x 45	5575



VERTICAL PLUNGER SINKING PUMP

Code word, "Plunsinker"

Cameron Vertical Plunger Sinking Pump

The photographic reproduction illustrates size 24x12x16 of this type, and shows the general construction of the CAMERON sinking pumps of larger size than those shown on previous pages. This has been adopted to accomplish the object of having ample valve area, and keeping the size of the valves within reasonable limits. The discharge chamber and pipe connection are on opposite sides to avoid making the air chamber excessively large, which would be the case with these larger pumps where the two are combined.

In addition to the sinking pumps listed on page 71, and also below, we can supply this type of sinking pump up to 1,000 gallons capacity per minute, but as the demand is limited, we do not keep them in stock.

Code Word	Price, with Iron Plunger and Steel Piston Rod	Diameter of Steam Cylinder Inches	Diameter of Plunger, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space occupied in Shaft, Inches	Weight
Caicos	...	16	10½	16	6.0	450	2½	4	8	6	52 x 61	6000
Caipha	...	18	10½	16	6.0	450	3	4	8	6	52 x 61	6200
Cairn	...	16	12	16	7.83	587	2½	4	10	8	52 x 61	7587
Caistor	...	18	12	16	7.83	587	4	4	10	8	52 x 61	7600
Calaf	...	20	12	16	7.83	587	4	5	10	8	61 x 74	8000
Calamo	...	22	12	16	7.83	587	4	5	10	8	61 x 74	8600
Calbe	...	24	12	16	7.83	587	4	5	10	8	61 x 74	9950

TANDEM DOUBLE STEAM END
VERTICAL PLUNGER SINKING PUMP. Code word "Tanplunsin."

Cameron Tandem Double Steam End Vertical Plunger Sinking Pump

Patent Applied for

THE purpose this design is intended to accomplish is to permit the pump to use the full pressure as nearly as possible during the time of its operation, and is particularly adapted for compressed air driven pumps.

If a pump as ordinarily constructed is calculated for a shaft which is to be sunk to a considerable depth, the power end must be made large enough for the maximum depth and, therefore, in a pump with a single steam cylinder a low pressure is accomplished by throttling the air down to a very low tension. It will be realized that this must occasion a considerable loss, for compressed air may be likened to a spring which, having been compressed to a high tension, is allowed to lose its force down to a low degree of tension to balance the load; thus a certain amount of power necessary to accomplish this compression is wasted.

It is not practically possible to adapt the pressure to every condition of head, but it is sought to minimize the loss by this construction.

With this pump the sinking may be accomplished by the use of the smaller cylinder alone, until the point is reached when more power is needed, when the large cylinder takes up the work and the smaller one reciprocates idly. A depth having been reached where the larger cylinder can no longer provide sufficient power, both cylinders operate together to the maximum depth.

Compound Sinker

Although the above constitutes the principal object of this design, the construction is such that it may be used as a compound pump, and all the advantages gained by using the steam expansively can be obtained. To one familiar with the use of compressed air, it is hardly necessary to explain that in practice the compound feature will not be ordinarily used with air; although it may be so used if proper measures are taken to avoid freezing, such as re-heating the compressed air before it enters the pump to a sufficient extent; but, if a high steam pressure is carried, excellent results may be obtained by compounding.

The pump will be arranged ordinarily to act non-compound, but we will supply it arranged in such a manner that it may be used either way, or both ways if so desired, as it can be accomplished without complication of mechanism or multiplication of parts.

If economical results are any object, try this pump.

"SIERRAS" PATTERN SECTIONALIZED VERTICAL PLUNGER SINKING PUMP. Code word, "Sierras"

Cameron Vertical Plunger Sinking Pump —Sierras Pattern

This is our regular Vertical Plunger Pump, built in section, the heaviest piece weighing not over 300 pounds. With our Mountain Pattern Plunger Pump, it has found its way on mule back and by other primitive modes of transportation over the Mountain Passes of Mexico, Colombia, Peru, Chili, and to other mining regions in Central and South America. The photographic reproduction illustrates No. 8, size 10x6x13. One larger size is illustrated and described on the following pages, 78 and 79.

Code Word	Size Number	Price, with Iron Plunger and Steel Rod	Diameter of Steam Cylinder, Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity per Minute at Ordinary Speed Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space occupied in Shaft, Inches	Weight
Chabris	6	...	8	4	12	.65	65	1	1½	3	2½	25 x 25	1502
Chalco	7	...	10	5	13	1.10	100	1¼	2	4	3	31 x 30	2560
Chamba		...	12	5	13	1.10	100	1½	2½	4	3	32 x 33	2750
Chandore	8	...	10	6	13	1.58	150	1¼	2	4	3½	31 x 31	2560
Chanute	9a	...	12	6	13	1.58	150	1½	2½	4	3½	32 x 33	2750

"SIERRAS" PATTERN SECTIONALIZED VERTICAL PLUNGER SINKING PUMP. Code word, "Pisierras"

Cameron Vertical Plunger Sinking Pump—Sierras Pattern

When our No. 9a size, 12x6x13, was built, we found we had reached the limit of this type of pump, and for a pump having larger capacity it became necessary to alter the design to the one shown on opposite page, which enables us to divide up the heaviest piece (the valve chest) into two parts, in order that no separate piece would be more than 300 lbs. in weight.

Only the one size listed below has been made like this, and we do not think it is possible to make any larger size this way, but this size is the largest in which this limit of weight can be obtained.

Code Word	Size Number	Price, with Iron Plunger and Steel Rod	Diameter of Steam Cylinder, Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity per Minute at Ordinary Speed, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space occupied in Shaft, Inches	Weight
Chapour	9	....	12	7	13	2.16	200	1½	2½	5	4	34x33	3230

SUCTION CONDENSER ATTACHED TO VERTICAL PLUNGER SINKING PUMP. Code word, "Succudet."

Cameron Suction Condenser

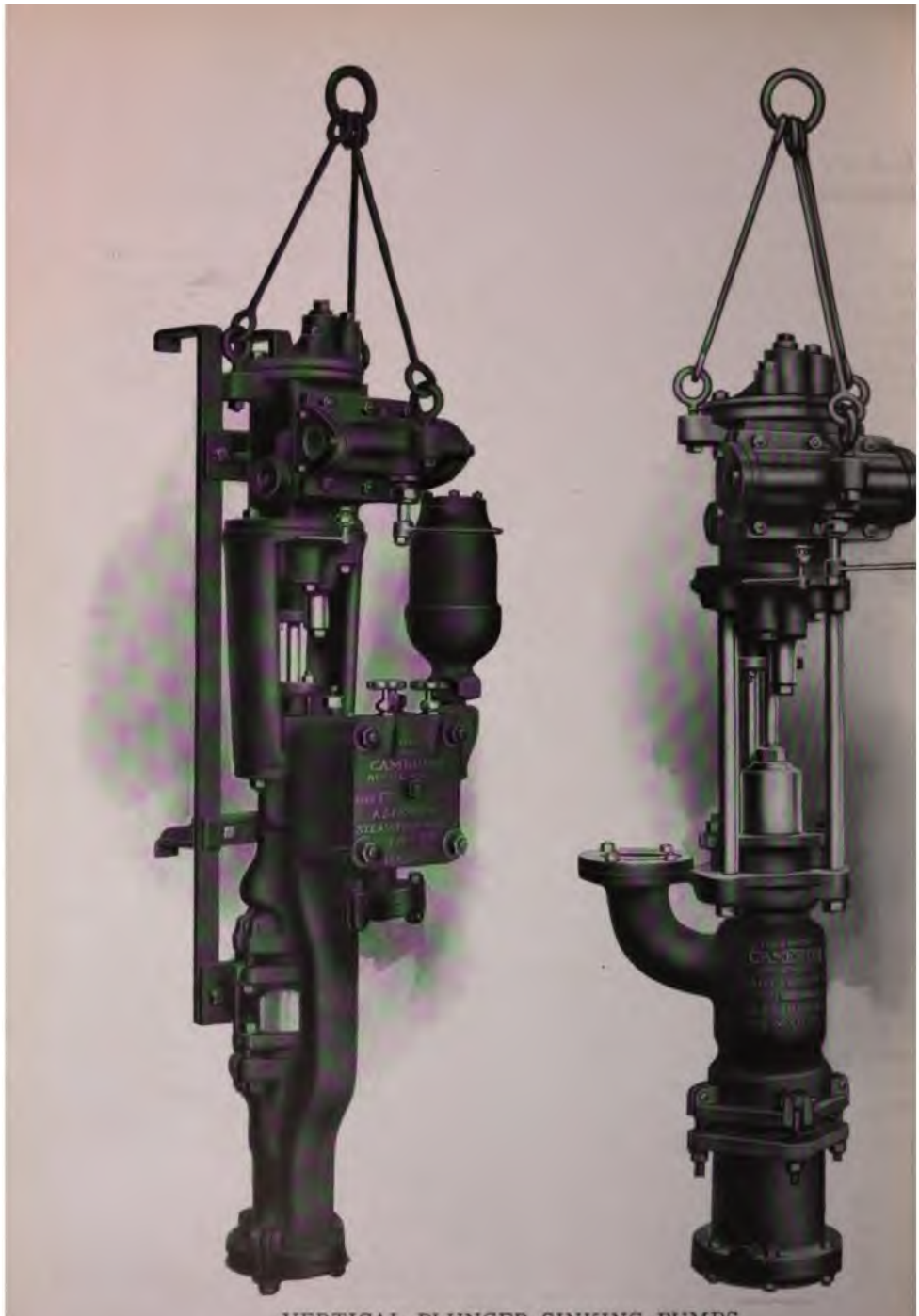
In mines, particularly, it is sometimes a very difficult matter to decide how to dispose of the exhaust steam.

The use of a suction condenser offers a solution of the difficulty. The CAMERON Suction Condenser has the merit of not presenting any resistance to the free inflow of the water, while at the same time it is exceedingly effective in taking care of the exhaust steam by condensing it and permitting it to enter the pump as water, through the suction opening, from which it is discharged to the surface. It has also the additional advantage of relieving the steam end of back pressure, as a partial vacuum is formed proportionate to the height of suction lift.

Be sure that the water cylinder is fully charged before the exhaust steam is turned into the condenser by allowing the pump to exhaust into the atmosphere until the pump has become filled with water, when the three-way valve may be turned and the exhaust admitted to condenser.

An air leak is fatal to the successful working of this as of any condensing apparatus. The suction condenser and exhaust pipe leading thereto are shown by dark portion on cut on opposite page.

Code Word	Size of Pump	Price of Condenser with Exhaust Pipe	Exhaust Pipe	Suction Pipe	Weight
Cuamo	6 x 3 x 7	....	1	2	40
Cubero	No. 5	....	1½	2½	100
Cublize	" 6	....	1½	3	100
Cucuta	" 7	....	2	4	150
Cudrefin	12 x 5 x 13	....	2½	4	150
Cuenca	No. 8	....	2	4	150
Cuisery	" 9a	....	2½	4	175
Culborne	14 x 6 x 13	....	3	4	175
Culebra	No. 9	....	2½	5	175
Cullera	" 9b	....	3	5	200
Culloor	16 x 7 x 16	....	4	5	250
Culna	No. 10	....	3	5	225
Culpeper	" 11	....	4	5	250
Cuma	16 x 9 x 16	....	4	6	250
Cumbal	No. 12	...	4	6	250



VERTICAL PLUNGER SINKING PUMPS

Prospector's Sinking Type.
Code word, "Prospector."

Contractor's Differential Type.
Code word, "Contractor."

Cameron Vertical Plunger Sinking Pumps

Two distinct designs of Vertical Plunger Sinking Pumps are illustrated on the opposite page. Both have steam ends possessing the unique features of the CAMERON pump, but the Prospector's Sinking Pump is of the same general character as our Regular Vertical Plunger Sinking Pumps and is suitable for quite considerable elevations, while the contractor's Differential Plunger Pump is better adapted for lesser elevations and is much lighter in weight and is not provided with hooks although slings are furnished.

Cameron Prospector's Sinking Pump

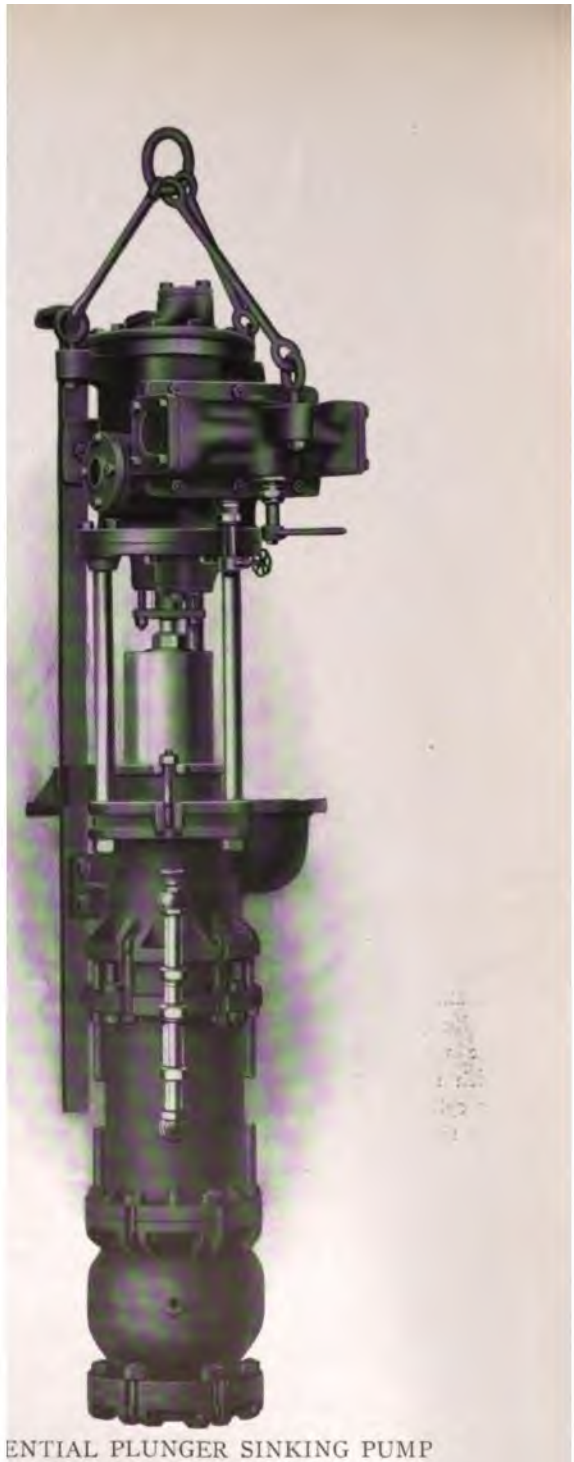
This type is very similar to our Vertical Plunger Sinking Pattern illustrated on pages 68 and 70 and described on pages 69 and 71. It was designed to meet the requirements of those who need a sinking pump for prospecting or any situation where a pump of larger capacity is unnecessary.

Code Word	Price, with Iron Plunger and Steel Piston Rod	Diameter of Steam Cylinder Inches	Diameter of Plunger, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space occupied in Shaft, Inches	Weight
Cervera	$250	6	3	7	21	28	¾	1	2	1½	27 x 21	740

Contractor's Differential Plunger Pump

The CAMERON Contractor's Differential Plunger Sinking Pump illustrated on the opposite page, is particularly adapted for situations where the lift is light and the water contains considerable sediment. Lightness is one of the features, which is attained by discarding the valve chest and placing the valves in the lower cylinder and plunger. The flow of the water is in one direction, thus reducing the frictional resistance and preventing the accumulation of sediment over the valves. The general construction is similar to our Differential Sinking Pump described on page 85.

Code Word	Price, with Iron Plunger and Steel Piston Rod	Diameter of Steam Cylinder Inches	Diameter of Upper Plunger Inches	Diameter of Lower Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Crastino	$225	6	4	6	7	.39	50	¾	1	3	2½	475



ENTIAL PLUNGER SINKING PUMP
Code word, "Differplun"

Cameron Differential Plunger Sinking Pump

The photographic reproduction on the opposite page illustrates size 14x8 and 12x13 of this type, which was originally designed for a light machine discharging a considerable quantity of water to a limited elevation.

For this work it is particularly well adapted, as the water flows in a steady current in one direction, and is not retarded by its passage through the valves, which have large interstices. These qualities permit of a comparatively high speed, and the discharge of a large quantity of water. The weight of the machine is reduced by discarding the valve chest and air chamber, as the valves are in the lower cylinder and plunger, and the upper part of the plunger performs the function of an air chamber. The construction of the water end is very simple, so that an exhaustive explanation is unnecessary. On the up-stroke twice the amount of water discharged is drawn into the lower chamber, and on the down-stroke one-half of that drawn into the lower chamber is discharged. Thus, on the up-stroke a certain quantity equal to one-half of that drawn into the cylinder is discharged, and on the down-stroke the other half is forced into the discharge column, but the flow is always in one direction. This prevents the accumulation of sand on the valves, and avoids the trouble due to this condition.

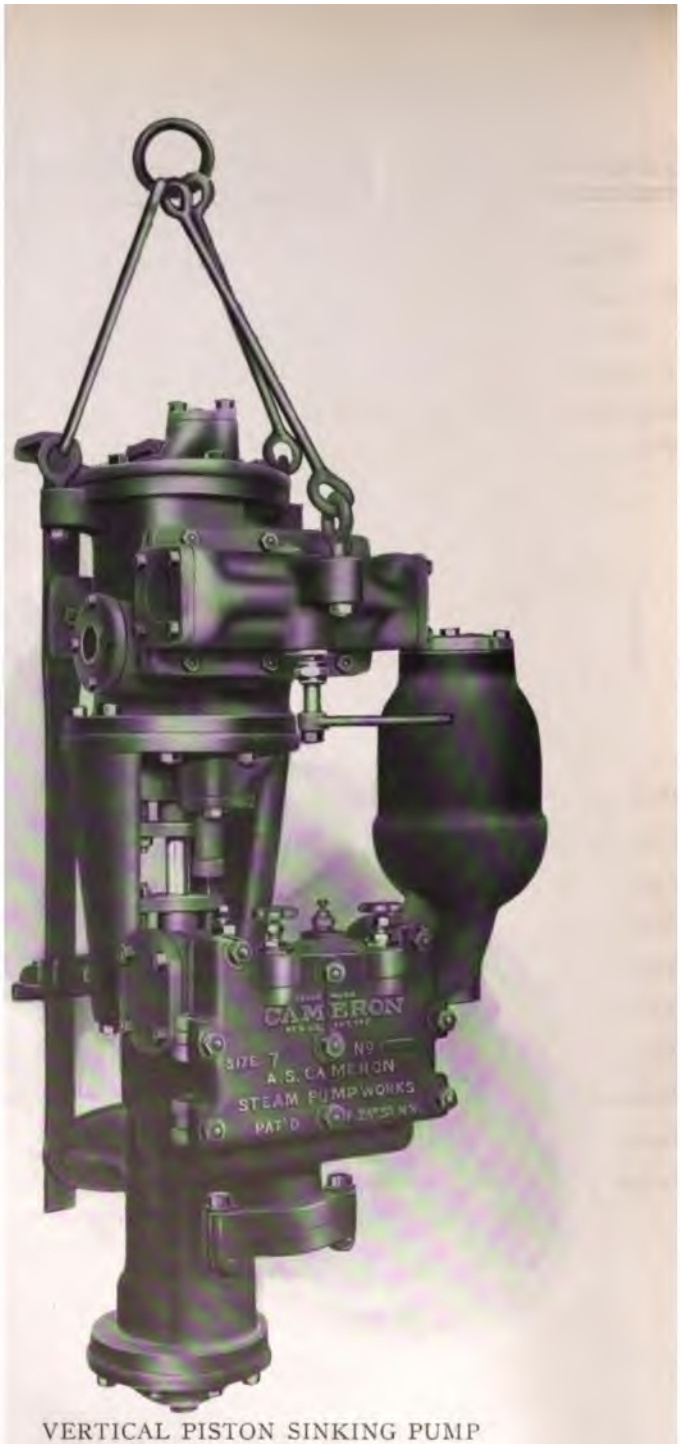
The lower or suction valves are readily accessible, being contained in the lower chamber, and may be reached by loosening the swing bolts and loosening the chamber as far as the long bolts will permit, thus providing for their inspection or removal.

The discharge valves are contained in a plate in the lower end of the plunger and are rendered accessible by loosening the upper set of swing bolts and lowering the pump chamber to the full extent of the long swing bolts, thus allowing the removal of the valve plate, etc.

This type is also suitable as a bilge or wrecking pump, as it is designed for maximum capacity with minimum weight and space.

These pumps are equipped with hooks for suspending to shaft timbers.

Code Word	Price, with Iron Plunger and Steel Piston Rod	Diameter of Steam Cylinder Inches	Diameter of Upper Plunger Inches	Diameter of Lower Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Clackamas	.....	7	3½	5	12	.05	50	1	1½	3½	2	...
Clanton	.....	8	4	6	12	.65	65	1	1½	4	2½	...
Claquato	.....	10	5	7	13	1.10	100	1¼	2	4	3	...
Clarina	.....	12	5	7	13	1.10	100	1½	2½	4	3	...
Clausthal	.....	10	6	8	13	1.58	150	1¾	2	5	3½	...
Clecy	.....	12	6	8	13	1.58	150	1½	2½	5	3½	...
Clements	.....	14	6	8	13	1.58	150	2	3	5	3½	...
Cleona	.....	12	7	9	13	2.16	200	1½	2½	6	4	...
Clerff	.....	14	7	9	13	2.16	200	2	3	6	4	...
Clifton	.....	16	7	9	16	2.66	200	2½	4	6	4	...
Climax	.....	14	8	12	13	2.83	261	2	3	8	5	...
Cliola	.....	16	8	12	16	3.48	261	2½	4	8	5	...
Clitumno	.....	16	9	13	16	4.40	330	2½	4	8	5	...
Clonmel	.....	16	10	14	16	5.44	400	2½	4	10	8	...
Clontarf	.....	18	12	17	16	7.83	587	3	4	10	8	...



VERTICAL PISTON SINKING PUMP

Code word, "Sinkpiston"

Cameron Vertical Piston Sinking Pump

The photographic reproduction illustrates our Vertical Piston Sinking Pump No. 7, size 10x5x13.

This pump is considerably lighter than our vertical plunger pump, and we are able to offer it at a lower price. It possesses many of the excellent qualities of the plunger type, and we believe it is the best piston sinking pump on the market, yet we prefer and recommend the plunger type for gritty water.

Code Word	Size Number	Price, with Removable Bushing, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space occupied in Shaft, Inches	Weight
Dacia	5	$320	7	3½	12	.5	50	1	1½	2½	2	24 x 24	1064
Dafar	6	370	8	4	12	.65	65	1	1½	3	2½	25 x 25	1102
Dagil	7	475	10	5	13	1.10	100	1¼	2	4	3	31 x 30	1691
Dahlen	8	500	10	6	13	1.58	150	1¼	2	4	3½	31 x 31	1790
Daina	9	575	12	7	13	2.16	200	1½	2½	5	4	34 x 33	2219
Dalkeith	10	775	14	9	18	4.96	330	2	3	6	5	41 x 38	3740
Dallu	...	850	16	9	16	4.40	330	2½	4	6	5	42 x 39	4385
Damaran	...	950	18	9	16	4.40	330	3	4	6	5	43 x 40	4790
Danda	...	...	16	10½	16	6.0	450	2½	4	8	6	43 x 41	5000
Dankali	...	...	18	10½	16	6.0	450	3	4	8	6	44 x 44	5250

TANDEM VERTICAL SINKING PUMP

Code word "Tanpisink."

Cameron Tandem Vertical Sinking Pump

WHERE the vertical lift is considerable, and the size of shaft limited, two steam ends of the same diameter working together may be used in lieu of a single steam end of larger diameter, and they may be connected up in such a manner that one steam end will act independently of the other.

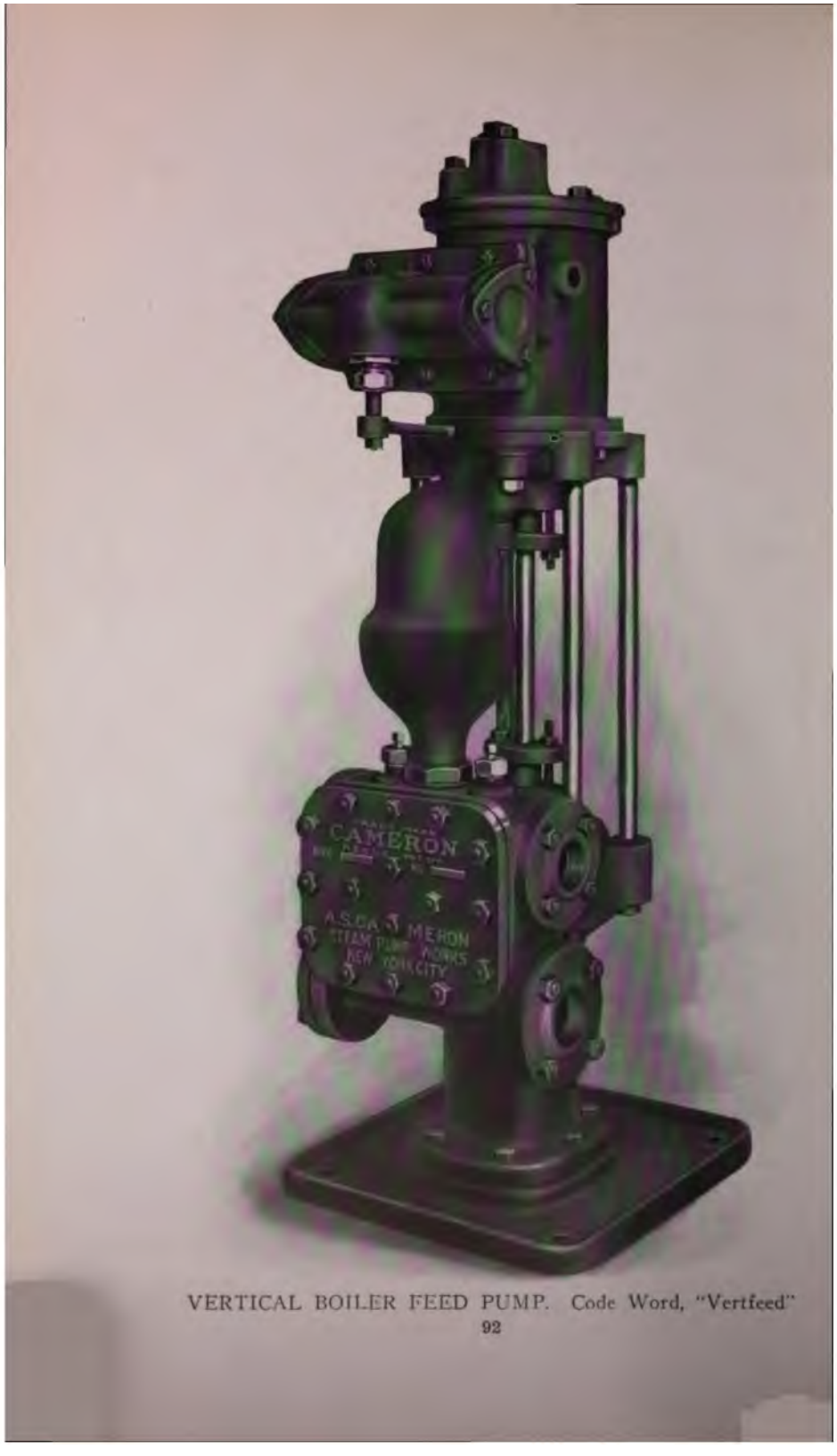
This is also a measure of economy when compressed air is used, as, instead of using both steam ends and throttling the air to a low tension on the upper half of the work, a higher pressure may be used on one cylinder until a depth is reached when both steam ends are needed, when they will then operate together to the bottom of the shaft. During the period when one steam end is sufficient, the other may be reciprocating idly.

TELESCOPIC JOINT. Code word, "Telesjoint"

Cameron Telescopic Joint

This telescopic joint supplies a convenient means for lifting a pump when blasting, and avoids disconnecting the pipes. We usually make them for sixteen foot travel, to enable the operator to drop the pump that distance without disturbing the rest of the pipe. By its use irregular lengths of pipe may be added, whereas otherwise, when the pump is lowered, the pipe would have to be cut in equal lengths. The outside is made of galvanized pipe, and the inside of brass tubing when desired; or with both inside and outside pipes of galvanized iron.

Code Word	Diameter of Pipe Inches	Length of Travel Feet	Price, with Galvanized Iron Inner Tube	Price, with Brass Inner Tube	Weight
Croagh	1¼	16	.....	.....	130
Cromarty	1½	16	.....	.....	175
Cronstadt	2	16	.....	.....	220
Croom	2½	16	.....	.....	300
Cropsey	3	16	.....	.....	400
Crosshill	4	16	.....	.....	500
Crozon	5	16	.....	.....	600
Cruger	6	16	.....	.....	885
Crural	8	16	.....	.....	1400



VERTICAL BOILER FEED PUMP. Code Word, "Vertfeed"

Cameron Vertical Boiler Feed Pump

The photographic reproduction shows a vertical piston pump on base of the size 6x4x7. Where it is known its virtues are appreciated, since it possesses every necessary attribute of a perfect direct-acting pump, and occupies but little space. Although shown on a base-plate, it can be made to bolt to a wall or bulkhead by means of lugs cast on the back. In common with all CAMERON pumps, no working part is exposed except a small part of the rod, which may also be covered if necessary. The steam end may be adapted to work under any steam pressure, no matter how high, and the water end is fitted with a removable bushing or lining, which may be taken out and replaced with a new one in a few minutes, thus avoiding any delay when it becomes necessary to renew the working barrel of the cylinder on account of wear.

Code Word*	Price, with Removable Iron Lining and Steel Piston Rod	Price, with Removable Bushing, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity at Ordinary Speed per Minute	Boilers, in Horse Power they will supply at 1-3 Ordinary Speed, based on 30 Lbs. of Water per Horse Power per Hour	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Drabund	....	....	3½	2	4	8	40	⅜	½	1¼	1	200
Dracut	....	....	4	2	6	12	60	⅜	½	1¼	1	300
Dragonera	....	....	5	2½	6	18	90	½	¾	1½	1¼	380
Dragoni	....	....	5	3	7	28	140	½	¾	2	1½	520
Dragor	....	....	5	3½	7	38	190	½	¾	2½	2	540
Dragten	....	....	6	4	7	50	250	¾	1	2½	2	630

*If pump with movable iron lining and steel piston rod is desired, add the word **"Ironbush."** If pump with movable pump lining, piston and piston rod of composition is desired, add the word **"Compobush."**

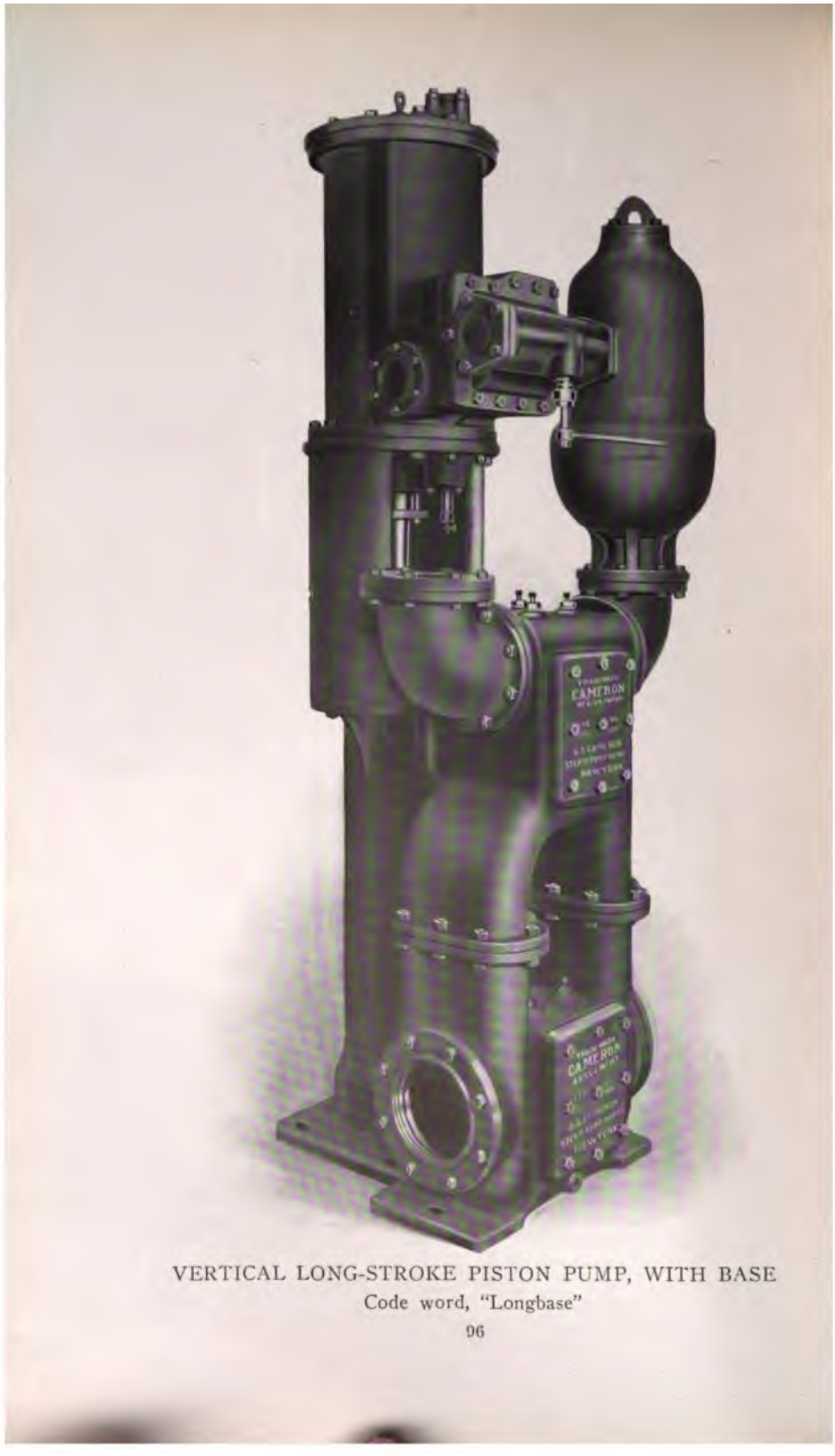
VERTICAL SHORT-STROKE PISTON PUMP, WITH BASE.

Code word, "Shortbase"

Cameron Vertical Short-Stroke Piston Pump With Base

This pump is adapted for situations where it is necessary to install a pump in a limited space, such as a well, shaft, or sink. The photographic reproduction illustrates size 12x7x13.

Code Word	Size Number	Price, with Removable Bushing, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Deakover	5	.....	7	3½	12	.5	50	1	1½	2½	2	1260
Deanston	6	.....	8	4	12	.65	65	1	1½	3	2½	1300
Dease	7	.....	10	5	13	1.10	100	1¼	2	4	3	2000
Deba	8	.....	10	6	13	1.58	150	1¼	2	4	3½	2050
Degesby	9	.....	12	7	13	2.16	200	1½	2½	5	4	2600
Deglia	10	.....	14	9	18	4.96	330	2	3	6	5	4400
Dego	..	.....	16	9	16	4.40	330	2½	4	6	5	5160
Deinum	..	.....	18	9	16	4.40	330	3	4	6	5	5650
Deira	..	.....	16	10½	16	6.0	450	2½	4	8	6	5600
Dekkan	..	.....	18	10½	16	6.0	450	3	4	8	6	6100



VERTICAL LONG-STROKE PISTON PUMP, WITH BASE

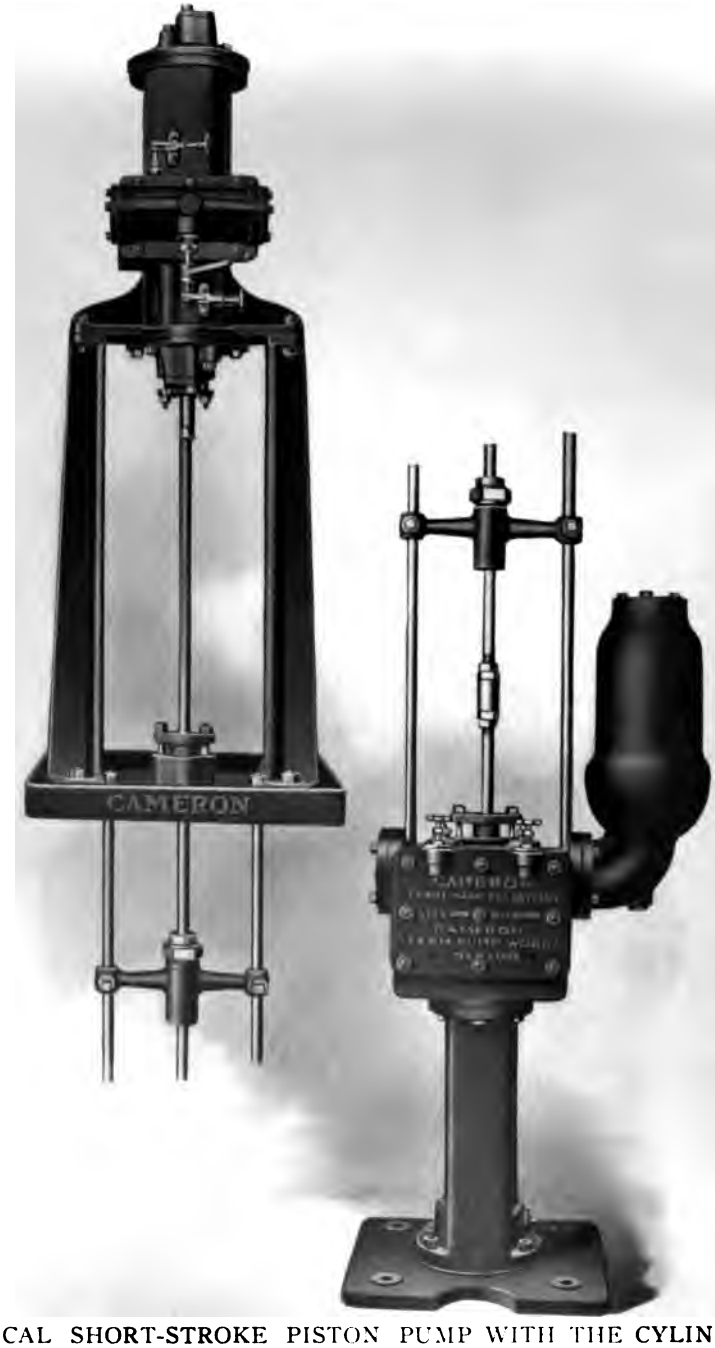
Code word, "Longbase"

Cameron Vertical Long-Stroke Piston Pump With Base

This pump is adapted for situations where it is necessary to install a pump in a limited space, such as a well, shaft or sink. The advantages claimed for our horizontal long-stroke pump, on page 23, apply equally to this type. The photographic reproduction illustrates size 20x12x36.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke in Gallons	Capacity at Ordinary Speed per Minute in Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Diadem	....	....	10	7	25	4.17	225	1¼	2	5	4	3200
Diano	....	....	12	7	25	4.17	225	1½	2½	5	4	3325
Dieburg	....	....	14	7	25	4.17	225	2	3	5	4	3900
Diekirch	....	....	16	7	25	4.17	225	2½	4	5	4	4575
Diemel	....	....	14	8	25	5.44	290	2	3	5	4	4300
Diessen	....	....	16	8	25	5.44	290	2½	4	5	4	4975
Dignano	....	....	14	9	33	9.08	350	2	3	6	5	6000
Dihong	....	....	16	9	33	9.08	350	2½	4	6	5	6500
Dilli	....	....	18	9	33	9.08	350	3	4	6	5	7050
Dinant	....	....	16	10½	33	12.37	500	2½	4	10	8	8100
Dingle	....	....	18	10½	33	12.37	500	3	4	10	8	8650
Dinia	....	....	20	10½	33	12.37	500	4	5	10	8	9640
Dinkira	....	....	18	12	36	17.6	660	3	4	12	10	11554
Dipso	....	....	20	12	36	17.6	660	4	5	12	10	12600
Dirillo	....	....	22	12	36	17.6	660	4	5	12	10	13250
Dittfurt	....	....	24	12	36	17.6	660	4	5	12	10	14050

*If pump with iron water cylinder and steel piston rod is desired add the word **"Ironcll."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocll."**



VERTICAL SHORT-STROKE PISTON PUMP WITH THE CYLINDER SEPARATED. Code word, "Sapashort"

Cameron Vertical Short-Stroke Piston Pump, With the Cylinders Separated

The photographic reproduction illustrates No. 6, size 8x4x12.

This pump is adapted for raising water from rivers and deep wells, or wherever there is considerable fluctuation of the water level; the water cylinder can be placed below and the steam cylinder at the surface, and connected to it with the necessary rods and guides. By this arrangement, the steam cylinder is never submerged, and the inconvenience of having to go down into the well to attend to it is avoided.

Code Word*	Price, Iron Bushing and Steel Rods	Price, Composition Bushing and Rods	Size Number	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Price, Rods per foot	Weight, Rods per Foot	Weight
Doazit	....	....	5	7	3½	12	.5	50	1	1½	2½	2	84	20	2190
Doberan	....	....	6	8	4	12	.65	65	1	1½	3	2½	4	20	2230
Doboka	....	....	7	10	5	13	1.10	100	1¼	2	4	3	6	30	2880
Dobra	....	....	8	10	6	13	1.58	150	1¼	2	4	3½	6	30	2930
Dobromil	....	....	9	12	7	13	2.16	200	1½	2½	5	4	6	30	3470
Docea	....	....	10	14	9	18	4.96	330	2	3	6	5	9	40	5100
Dohul	....	....	..	16	9	16	4.40	330	2½	4	6	5	11	45	5750
Dolm	....	....	..	18	9	16	4.40	330	3	4	6	5	12	50	6000
Domanis	....	....	..	16	10½	16	6.0	450	2½	4	8	6	11	45	6100
Domfront	....	....	..	18	10½	16	6.0	450	3	4	8	6	12	50	6650

*If pump with iron bushing and steel piston rod is desired, add the word **"Ironbush."**

If pump with water cylinder bushing, piston and piston rod of composition is desired, add the word **"Compobush."**

VERTICAL LONG-STROKE PISTON PUMP WITH THE CYLINDERS SEPARATED. Code word, "Sepalong"

Cameron Vertical Long-Stroke Piston Pump, With the Cylinders Separated

The photographic reproduction illustrates size 20x12x36. It is adapted for the same situations as our short-stroke pump on page 99, and the same advantages claimed for our long-stroke pumps also apply to this type.

Code Word*	Price, with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity per Stroke Gallons	Capacity at Ordinary Speed per Minute, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Dubari	....	....	10	7	25	4.17	225	1¼	2	5	4	3500
Dubenka	....	....	12	7	25	4.17	225	1½	2½	5	4	3625
Dubno	....	....	14	7	25	4.17	225	2	3	5	4	4200
Dubozari	....	....	16	7	25	4.17	225	2½	4	5	4	4875
Duero	....	....	14	8	25	5.44	290	2	3	5	4	4600
Dukora	....	....	16	8	25	5.44	290	2½	4	5	4	5275
Dulas	....	....	14	9	33	9.08	350	2	3	6	5	6400
Dulwich	....	....	16	9	33	9.08	350	2½	4	6	5	6900
Duna	....	....	18	9	33	9.08	350	3	4	6	5	7450
Dunblane	....	....	16	10½	33	12.37	500	2½	4	10	8	8500
Dunglow	....	....	18	10½	33	12.37	500	3	4	10	8	9050
Dunkeld	....	....	20	10½	33	12.37	500	4	5	10	8	10040
Dunnet	....	....	18	12	36	17.6	660	3	4	12	10	11954
Dunnose	....	....	20	12	36	17.6	660	4	5	12	10	13000
Dunster	....	....	22	12	36	17.6	660	4	5	12	10	13650
Durben	....	....	24	12	36	17.6	660	4	5	12	10	14550

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcll."**
If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocll."**

Steam End

Sectional View—Working Barrel

DEEP WELL ENGINE. Code word, "Deepwell"

Cameron Deep Well Engine

This pump is designed for elevating water from artesian or bored wells, where the water lies too far below the surface to be within reach of an ordinary pump. It is simple and self-regulating in every way, requires no attention, and will pump water from any depth. There are no working parts exposed to damage or rust; and it will be noticed that, unlike other pumps with inside valve movements, the steam-chest is placed crosswise in a horizontal position, so that the steam-chest plunger moves quietly from side to side and does not rise and fall with the unequal momentum due to its weight. The pump bucket discharges on the up stroke, while the upper plunger is of an area equal to one-half that of the lower bucket and discharges upon the down stroke, so that the flow of water is very uniform and regular.

Whenever it becomes necessary to pull out or examine the working barrel, pump rods or piping, by an ingenious arrangement the whole steam end with column and base can be instantly rolled back upon the bed-plate away from the mouth of the well. This pump is supplied with our patent steam and exhaust cut off, which insures uniformity between the up and down stroke and avoidance of concussion at the ends of stroke. The photographic reproduction illustrates No. 5, size 7x36.

Deep Well Engine							
Code Word	Size Number	Price	Diameter of Steam Cylinder Inches	Stroke of Piston Inches	Steam Pipe	Exhaust Pipe	Weight
Edam	3	$275	6	12	3/4	1	1038
Edd	5	400	7	36	1	1 1/2	2171
Eder	6	450	8	36	1	1 1/2	2190
Edrei	7	500	10	36	1 1/4	2	2631
Edrenos	9	600	12	36	1 1/2	2 1/2	2986
Edrum	10	800	14	36	2	3	3350
Edwina	11	925	16	36	2 1/2	4	5564

Working Barrels					
Code Word	Price	Inside Diameter of Cylinder Inches	Length of Stroke Inches	Capacity at Ordinary Speed per Minute Gallons	Weight
Egara	.....	2 1/4	36	10	.....
Egerdir	.....	2 1/4	36	15	.....
Egga	.....	3 1/4	36	22	.....
Egham	.....	3 3/4	36	29	.....
Egholm	.....	4 1/4	36	37	.....
Egitto	.....	4 3/4	36	46	.....
Egris	.....	5 1/4	36	57	.....
Egt	.....	5 1/4	36	68	.....

MEMORANDUM

4 1/2	in. well will take	2 1/2	in. pipe and 2 1/4	in. bucket, or	3	in. flush-joint pipe, and 2 3/4	in. bucket.
5	in. well will take	3	in. pipe and 2 3/4	in. bucket, or	3 1/2	in. flush-joint pipe, and 3 1/4	in. bucket.
5 1/2	in. well will take	3 1/2	in. pipe and 3 1/4	in. bucket, or	4	in. flush-joint pipe, and 3 3/4	in. bucket.
6	in. well will take	4	in. pipe and 3 3/4	in. bucket, or	4 1/2	in. flush-joint pipe, and 4 1/4	in. bucket.
6 1/2	in. well will take	4 1/2	in. pipe and 4 1/4	in. bucket, or	5	in. flush-joint pipe, and 4 3/4	in. bucket.
7 1/2	in. well will take	5	in. pipe and 4 3/4	in. bucket, or	6	in. flush-joint pipe, and 5 3/4	in. bucket.
8	in. well will take	6	in. pipe and 5 3/4	in. bucket, or	7	in. flush-joint pipe, and 6 3/4	in. bucket.
9	in. well will take	7	in. pipe and 6 3/4	in. bucket, or	——	in. flush-joint pipe, and ——	in. bucket.
10	in. well will take	8	in. pipe and 7 5/8	in. bucket, or	——	in. flush-joint pipe, and ——	in. bucket.
12	in. well will take	9	in. pipe and 8 1/2	in. bucket, or	10	in. flush-joint pipe, and 9 1/2	in. bucket.

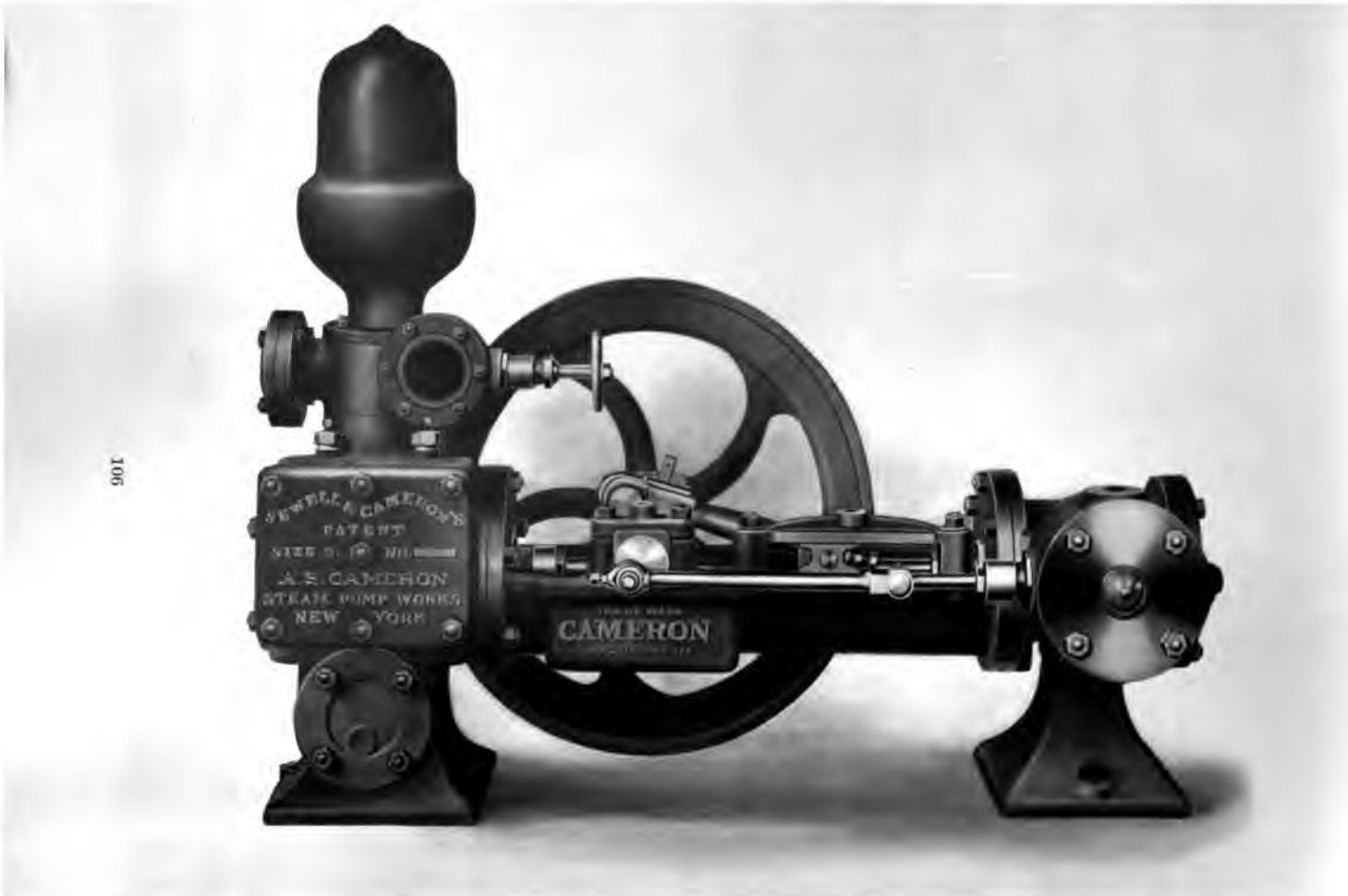
COMBINED PUMP AND BOILER. Code word, "Pumpboiler"

Cameron Combined Pump and Boiler

Our photographic reproduction illustrates a complete pumping outfit, only requiring the suction and discharge pipes to be connected to make it ready for work. The boiler is of the vertical tubular type, and is large enough in each case to enable the pump to run to its rated capacity. The pump is placed on the floor in the larger sizes, and the smaller ones rest on a plate bolted to the bed-plate of boiler similar to the accompanying illustration, which shows our No. 4, size, 7x3½x7. All pumps furnished with boiler have composition-lined water cylinders and composition piston rods.

A separate boiler feeding attachment is supplied with all boilers. Prices here listed do not include smoke stack.

Code Word	Size Number	Price of Boiler and Pump Combined	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Ordinary Speed per Minute, Strokes	Capacity at Ordinary Speed per Minute, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Diameter of Boiler Inches	Height of Boiler Inches	Weight
Faaborg	1	$370	4	2	6	.081	150	12	⅜	½	1¼	1	24	48	1500
Fabara	2	410	5	2½	6	.12	150	18	½	¾	1½	1¼	24	60	1650
Facone	3	450	6	3	7	.21	133	28	¾	1	2	1½	24	72	1950
Fadd	3a	475	6	3½	7	.29	133	38	¾	1	2½	2	24	72	1970
Faenza	4	550	7	3½	7	.29	133	38	¾	1	2½	2	30	60	2140
Fagnano	4a	570	7	4	7	.39	133	50	¾	1	2½	2	30	60	2150
Fajardo	5	660	7	3½	12	.5	100	50	1	1½	3	2½	30	84	3050
Falaise	5b	720	7	5	13	1.10	90	100	1	1½	4	3	30	84	3300
Falces	6	785	8	4	12	.65	100	65	1	1½	3	2½	36	78	3820
Falkirk	6a	820	8	5	13	1.10	90	100	1	1½	4	3	36	78	4070
Faltsi	7	1000	10	5	13	1.10	90	100	1¼	2	4	3	42	87	5500
Fallum	8	1035	10	6	13	1.58	90	150	1¼	2	4	3½	42	87	5550
Faniso	9	1200	12	7	13	2.16	90	200	1½	2½	5	4	42	111	6870
Fano	10a	1385	14	8	13	2.83	90	261	2	3	5	5	48	108	8770
Faradis	10	1600	14	9	18	4.96	67	330	2	3	6	5	48	108	10400


JEWELL & CAMERON'S
PATENT
A.S. CAMERON
STEAM PUMP WORKS
NEW YORK
CAMERON

Sewell and Cameron Crank and Fly-Wheel Pump

To those who appreciate the merits of the crank and fly-wheel type, we confidently recommend this pump as embodying all the best features in design and construction that have been suggested by long experience. It is very strong and compact, the framing, slides, crank, shaft bearings and cylinder heads being cast in one piece. The valve chest is of the well-known CAMERON pattern, with large valve area, and there are two discharge openings. The water cylinder is lined with best composition, and the water piston rod and boxes are of the same metal. The photographic reproduction illustrates No. 3, size 7x4x6.

Code Word	Size Number	Price	Diameter of Steam Cylinder	Diameter of Water Cylinder	Stroke of Piston	Gallons Discharged per Revolution	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Gabas	1	....	5	3	6	.36	1	1½	2	1½	742
Gabera	2	....	6	3½	6	.5	1	1½	3	2½	1090
Gablonz	3	....	7	4	6	.66	1	1½	3	2½	1150
Gajar	3½	....	8	5	7	1.20	1½	2	4	3	1593
Gakova	4	....	10	6	7	1.70	1½	2	4	3½	1660
Galam	5	....	12	7	7	2.33	2	3	5	4	2625
Galaroza	6	....	14	9	7	4.0	2	3	6	5	3615
Galega	7	....	16	11	9	7.5	2½	4	8	6	8000
Galion	8	....	18	12	12	11.75	3	4	10	8	10600

CAMERON
PATENT
A.S.CAMERON
STEAM PUMP WORKS
NEW YORK

Cameron Power Pump

Unlike steam-driven pumps, machines of this type should be **proportioned exactly for the work** required of them. A direct acting steam pump, for instance, may be run at slow speed or much faster, may be suitable for a considerable elevation and used for a slight lift; but a power pump should be run at the number of revolutions for which it is designed, and the resistance must not exceed that for which it is calculated. For the diameter of pulley and width of belt, the strength of gears and other parts and centrifugal force of fly-wheel must all bear a certain relation to the duty required. Therefore, in writing about a power pump, the quantity of water to be discharged and the elevation or resistance to be overcome should be stated, to enable the manufacturer to determine the proper proportions upon which to base price. For example, a power pump of a certain size to elevate a given quantity of water 50 feet high would be much less expensive than one of the same size discharging water to a height of 500 feet. We guarantee our power pumps for any specified duty. They are constructed to run as smoothly as possible, and every consideration is given to durability. The water end is of our standard piston type, unless otherwise ordered, and we make them with two water ends and with cranks at right angles, for handling large quantities of water. The photographic reproduction illustrates size **7x12.**

Code Word*	Price with Iron Water Cylinder and Steel Piston Rod	Price, with Water Cylinder Lining, Piston and Piston Rod of Composition	Diameter of Water Cylinder Inches	Length of Stroke, Inches	Capacity per Revolution Gallons	Capacity at Ordinary Speed per Minute Gallons	Suction Pipe	Discharge Pipe	Weight
Habab	.....	.....	3	6	.36	30	2	1½	750
Habsal	.....	.....	3½	6	.5	40	2½	2	800
Haddeby	.....	.....	4	6	.66	52	2½	2	850
Hadleigh	.....	.....	3½	12	1.0	50	3	2½	1800
Hadres	.....	.....	4	12	1.30	65	3	2½	2100
Haffeer	.....	.....	4½	12	1.65	85	3	2½	2250
Hagenow	.....	.....	5	12	2.04	100	4	3	2500
Haggs	.....	.....	6	12	2.94	150	4	3½	4250
Haid	.....	.....	7	12	4.0	200	5	4	4600
Haiger	.....	.....	8	12	5.22	260	5	5	4700
Hajar	.....	.....	9	12	6.60	330	6	5	5000
Halibut	.....	.....	10	12	8.16	400	6	5	5200
Hallein	.....	.....	12	12	11.75	600	10	8	6000

*If pump with iron water cylinder and steel piston rod is desired, add the word **"Ironcll."** If pump with water cylinder lining, piston and piston rod of composition is desired, add the word **"Compocll."**

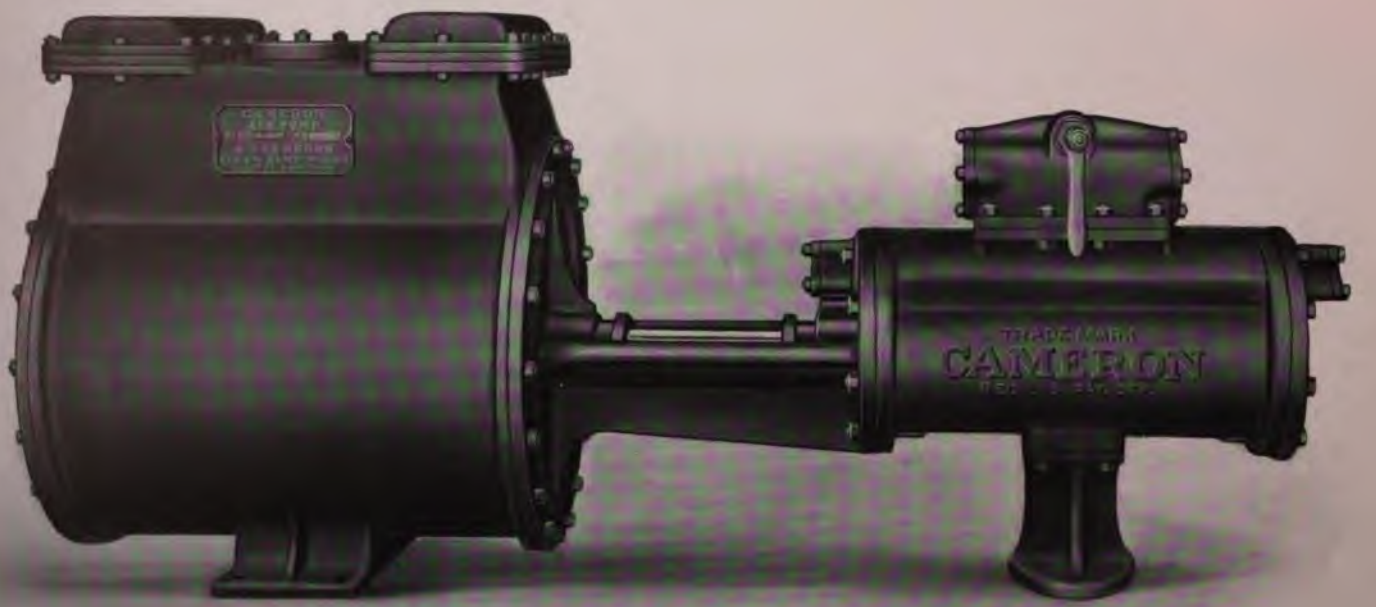
HYDRAULIC PRESSURE PUMP. Code word, "Hydraupres"

Wherever extraordinary pressures are required, as for hydraulic pressures used for various work, and for testing pipe and other purposes, the CAMERON Direct, Double-Acting, Hydraulic Pressure Pump is eminently qualified, and years of experience in building these machines has enabled us to furnish a pump in which is overcome all of the difficulties which the construction of this type of machine entails, and we can confidently assert that it will do its work in a thoroughly satisfactory manner, no matter what the pressure for which it is designed. Made with steel or bronze water cylinders. The photographic reproduction illustrates size 16x2½x18.

Code Word*	Price, with Bronze Water Cylinder	Diameter of Steam Cylinder Inches	Diameter of Plunger Inches	Stroke of Piston Inches	Capacity per Stroke Gallons	Steam Pipe	Exhaust Pipe	Pressure in Pounds per Square Inch	Weight
Iba	.....	7	¾	7	.013	¾	1	5.225	800
Iberg	.....	7	1	7	.024	¾	1	2,950	800
Iberia	.....	7	1¼	7	.037	¾	1	1,900	800
Iberville	.....	8	¾	12	.023	1	1½	6,850	1025
Ibicui	.....	8	1	12	.041	1	1½	3,840	1025
Ibos	.....	8	1¼	12	.064	1	1½	3,050	1025
Ibrah	.....	10	¾	13	.024	1¼	2	10,650	2100
Ibrim	.....	10	1	13	.044	1¼	2	6,000	2100
Icatu	.....	10	1¼	13	.069	1¼	2	3,850	2100
Iceland	.....	10	1½	13	.099	1¼	2	2,675	2100
Ichenheim	.....	10	2	13	.177	1¼	2	1,500	2100
Iconium	.....	10	2½	13	.276	1¼	2	960	2100
Idegem	.....	10	3	13	.398	1¼	2	650	2100
Idria	.....	12	1	13	.044	1½	2½	8,650	2300
Idurum	.....	12	1¼	13	.069	1½	2½	5,525	2300
Igatimi	.....	12	1½	13	.099	1½	2½	3,850	2300
Iglau	.....	12	2	13	.177	1½	2½	2,150	2300
Igrande	.....	12	2½	13	.276	1½	2½	1,375	2300
Ikarma	.....	12	3	13	.398	1½	2½	950	2300
Ikropa	.....	14	2	18	.245	2	3	2,875	2850
Ilanmore	.....	14	2½	18	.383	2	3	1 875	2850
Ilbono	.....	14	3	18	.551	2	3	1,300	2850
Ilgeldi	.....	16	2½	18	.383	2½	4	3.100	3100
Ilici	.....	16	3	18	.551	2½	4	2.150	3100
Ilissus	.....	16	3½	18	.750	2½	4	1,575	3600
Illescas	.....	18	2	20	.272	3	4	4.900	4500
Illimani	.....	18	2½	20	.425	3	4	3.100	4500
Illora	.....	18	3	20	612	3	4	2,150	4500
Ilsfeld	.....	18	4	20	1.088	3	4	1,200	5400
Imandra	.....	20	2	20	.272	4	5	6.000	6400
Imeritia	.....	20	2½	20	.425	4	5	3,850	6400
Inavale	.....	20	3	20	.612	4	5	2.675	6400
Indrapura	.....	20	4	20	1.088	4	5	1.500	7200
Induno	.....	24	2	20	.272	4	5	8 650	7600
Ingbert	.....	24	2½	20	.425	4	5	5,525	7600
Ingham	.....	24	3	20	.612	4	5	3 850	7600
Innerkip	.....	24	4	20	1.088	4	5	2 150	8500
Inveruno	.....	24	5	20	1.70	4	5	1.375	8500

*The pressure column gives approximately the pressure that can be exerted by the water plunger with 60 pounds of steam. No allowance made for friction.

HYDRAULIC PRESSURE PUMP. Code word, "Hydraupres"

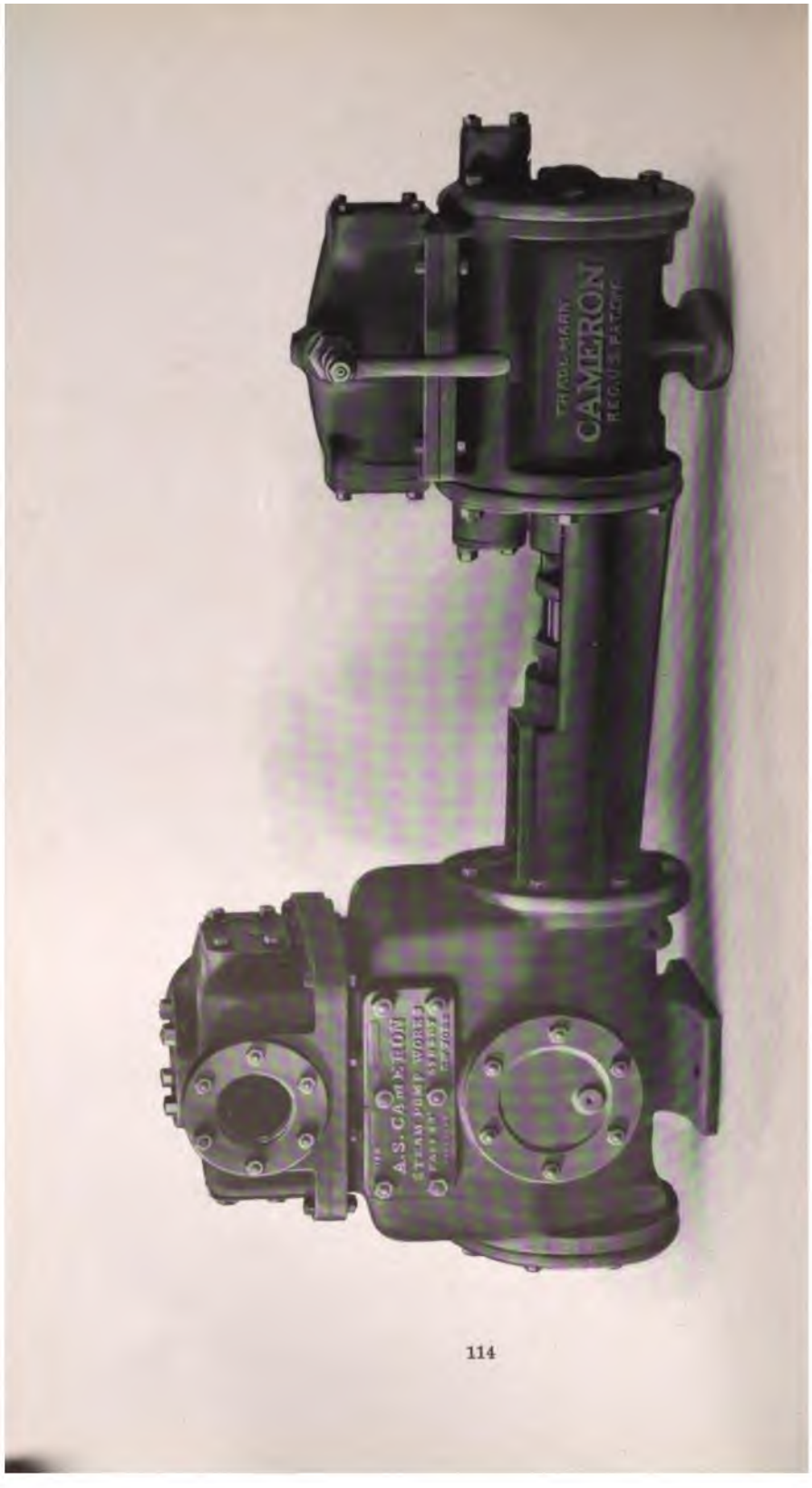


AIR PUMP OR COMPRESSOR. Code word, "Blower"

Cameron Air Pump or Compressor

Air pumps, as they are generally known, or blowers, which they are sometimes termed when the air is compressed but slightly, are really direct-acting air compressors, which, though not as economical in the use of steam as the more cumbersome and costly crank and fly-wheel machine, are still largely in demand for a great variety of purposes, as, for agitating oils, elevating acids requiring compression up to as high as fifty pounds, and rendering a large steam end necessary, and ventilating and blowing where small steam ends are sufficient. They are designed and constructed to give the best result, and are water-jacketed. The photographic reproduction illustrates size 10x20x30.

Code Word	Price	Diameter of Steam Cylinder Inches	Diameter of Air Cylinder Inches	Stroke of Piston, Inches	Cubic Feet of Free Air per Minute	Steam Pipe	Exhaust Pipe	Air Inlet	Air Outlet	Weight
Jaak		6	4	12	10	¾	1	2	2	575
Jabary		6	5	12	15	¾	1	2	2	585
Jabitaca		5	6	7	17	1¼	¾	2	2	205
Jablona		7	6	7	17	¾	1	2	2	320
Jabugo		6	6	12	20	¾	1	2	2	550
Jafarabad		7	8	13	35	1	1½	3	2	880
Jagan		8	8	13	35	1	1½	3	2	920
Jagodin		10	8	18	35	1¼	2	3	2	1314
Jahde		12	8	18	35	1½	2½	3	2	1464
Jako		14	8	18	35	2	3	3	2	1700
Jalacho		7	10	13	55	1	1½	4	4	1140
Jalangi		8	10	13	55	1	1½	4	4	1200
Jallore		10	10	13	55	1¼	2	4	4	1300
Jalovka		12	10	13	55	1½	2½	4	4	1450
Jalpuch		8	12	13	80	1	1½	4	4	1400
Jamari		7	15	24	124	1	1½	6	6	2000
Jamnitz		8	15	24	124	1	1½	6	6	2050
Jampol		10	15	24	124	1¼	2	6	6	2350
Janik		12	15	24	124	1½	2½	6	6	2500
Jansdorf		7	18	24	180	1	1½	6	6	2100
Jantra		8	18	24	180	1	1½	6	6	2150
Japara		10	18	18	180	1¼	2	6	6	2350
Jaragua		12	18	18	180	1½	2½	6	6	3200
Jarmello		10	20	30	220	1¼	2	8	8	4000
Jarnac		12	24	30	320	1½	2½	8	8	4350
Jaslo		14	24	30	320	2	3	8	8	4500
Jaunpoor		14	30	30	500	2	3	10	10	6500
Jauru		16	30	30	500	2½	4	10	10	6700

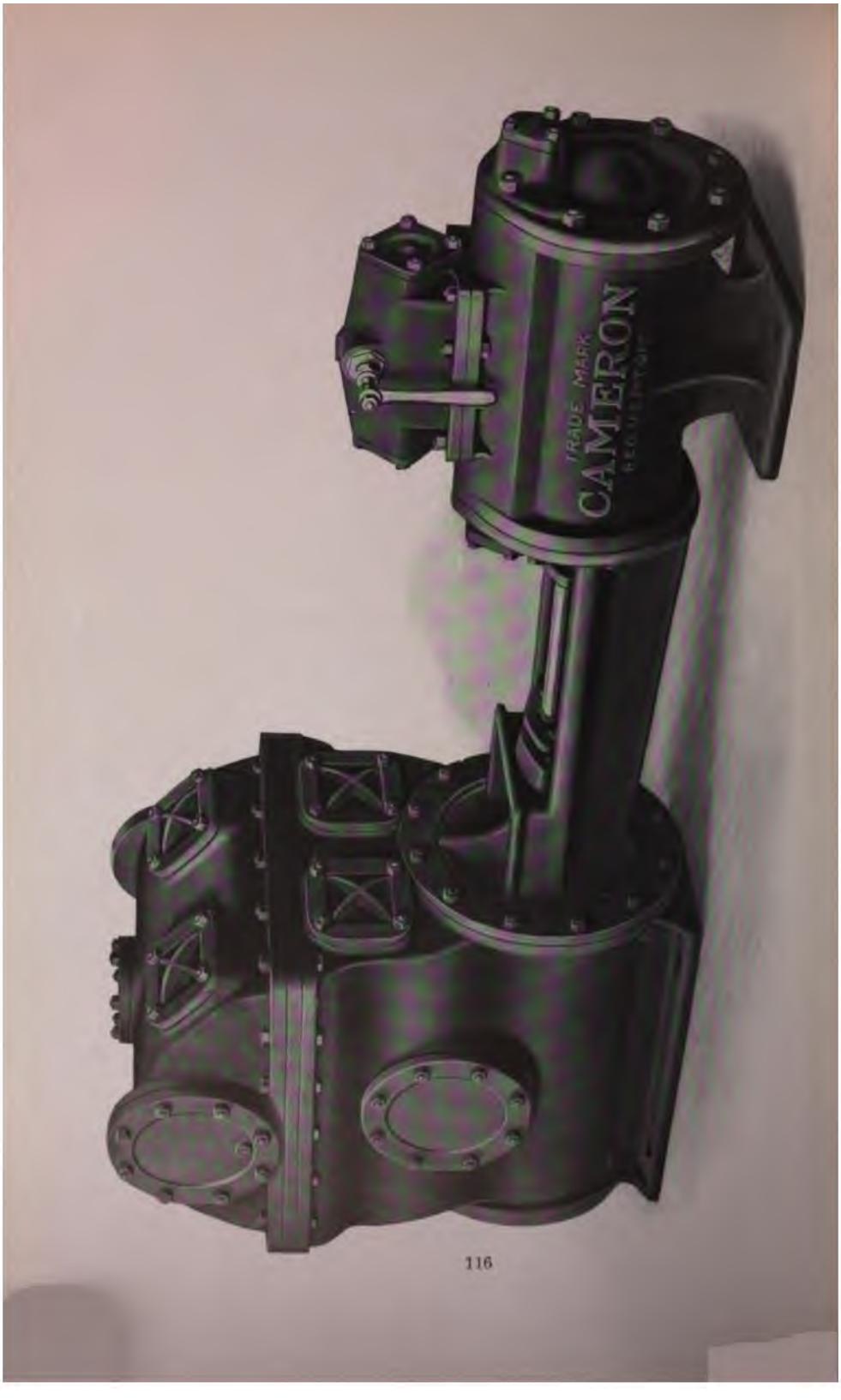

TRADE MARK
CAMERON
REGD. U.S. PAT. OFF.
A.S. CAMERON
STEAM PUMP WORKS

Cameron Direct-Acting Wet Vacuum Pump

The vacuum cylinder of the 12x16x18 pump and of all the smaller sizes, although practically the same in principle, presents a somewhat different appearance from the larger pump, as will be noticed by a comparison of the illustrations, pages 114 and 116.

The list below contains sizes, 16 inches and smaller. For larger sizes, see page 117. The photographic reproduction illustrates size 6x8x12.

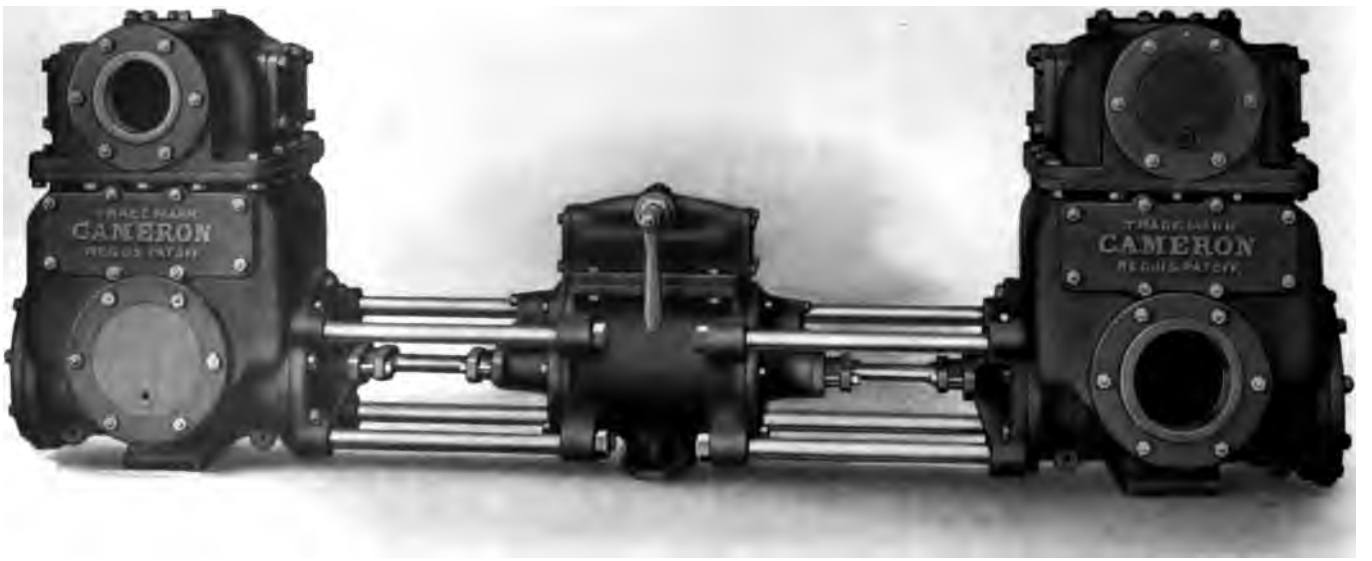
Code Word	Price	Diameter of Steam Cylinder, Inches	Diameter of Air Cylinder, Inches	Stroke of Piston Inches	Steam Pipe	Exhaust Pipe	Suction Pipe	Delivery Pipe	Weight
Kearney		3½	4	7	⅜	½	2	2	310
Kechan		3½	5	7	⅜	½	2½	2½	480
Keddel		4	6	7	⅜	½	3	3	630
Kedron		5	7	7	½	¾	3	3	800
Keever		6	8	12	¾	1	4	4	1200
Kehl		8	10	12	1	1½	5	5	1700
Keish		10	12	18	1¼	2	6	6	2500
Kelton		10	14	18	1¼	2	8	8	3900
Kemlic		12	16	18	1½	2½	8	8	4140


TRADE MARK
CAMERON

Direct-acting vacuum pumps are used where the vacuum required is not as perfect as that obtainable with a crank and fly-wheel pump. Many are used in various industries and also in connection with condenser for use with engines (referred to more fully on page 37). They are competent to handle large quantities of water mixed with air or vapor. They are furnished with or without drip-pan, as required. The photographic reproduction illustrates size 16x20x24.

For smaller sizes, see page 115.

Code Word	Price	Diameter of Steam Cylinder, Inches	Diameter of Air Cylinder, Inches	Stroke of Piston Inches	Steam Pipe	Exhaust Pipe	Suction Pipe	Delivery Pipe	Weight
Kain		14	18	24	2	3	10	10	6100
Kaisten		16	20	24	2	3	10	10	6400
Kalah		16	22	24	2	3	12	12	8257
Kamorta		18	24	24	2½	4	12	12	9600



COMBINED AIR AND CIRCULATING PUMP—DIRECT-ACTING. **Code word, "Comaircirc"**

The illustration shows a combination suitable for surface condenser, and is also used in connection with a jet condenser in cases where the water is used over again, having been cooled by means of cooling tower or other method. But we make many other combinations which would require too much space to illustrate, among which may be mentioned a combined vacuum and boiler feed pump, frequently used in connection with a Keel condenser. For larger sizes of this type refer to pages 120 and 121. The photographic reproduction represents size 10x12x12x12.

Code Word	Price	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Diameter of Air Cylinder Inches	Stroke of Piston, Inches	Steam Pipe	Exhaust Pipe	Suction of Water Cylinder	Discharge of Water Cylinder	Suction of Air Cylinder	Discharge of Air Cylinder	Weight
Kiama	.....	3½	3½	3½	7	⅜	½	2½	2	2	2	500
Kiang	.....	3½	4	4	7	⅜	½	2½	2	2	2	550
Kibar	.....	4	5	5	7	⅜	½	3	2½	2½	2½	945
Kidder	.....	5	6	6	7	½	¾	4	3	3	3	1240
Kidros	.....	6	7	7	7	¾	1	4	4	3	3	1485
Kielce	.....	7	8	8	7	¾	1	5	4	4	4	1600
Kifri	.....	7	8	8	12	1	1½	5	4	4	4	2100
Kijari	.....	8	9	9	12	1	1½	6	5	5	5	2900
Kila	.....	8	10	10	12	1	1½	6	5	5	5	3250
Kilbourn	.....	10	12	12	12	1¼	2	8	6	6	6	4000
Kilbride	.....	10	12	12	18	1¼	2	8	6	6	6	4570
Killinger	.....	12	14	14	18	1½	2½	10	8	8	8	6760
Kilrush	.....	14	16	16	18	2	3	10	8	8	8	7400

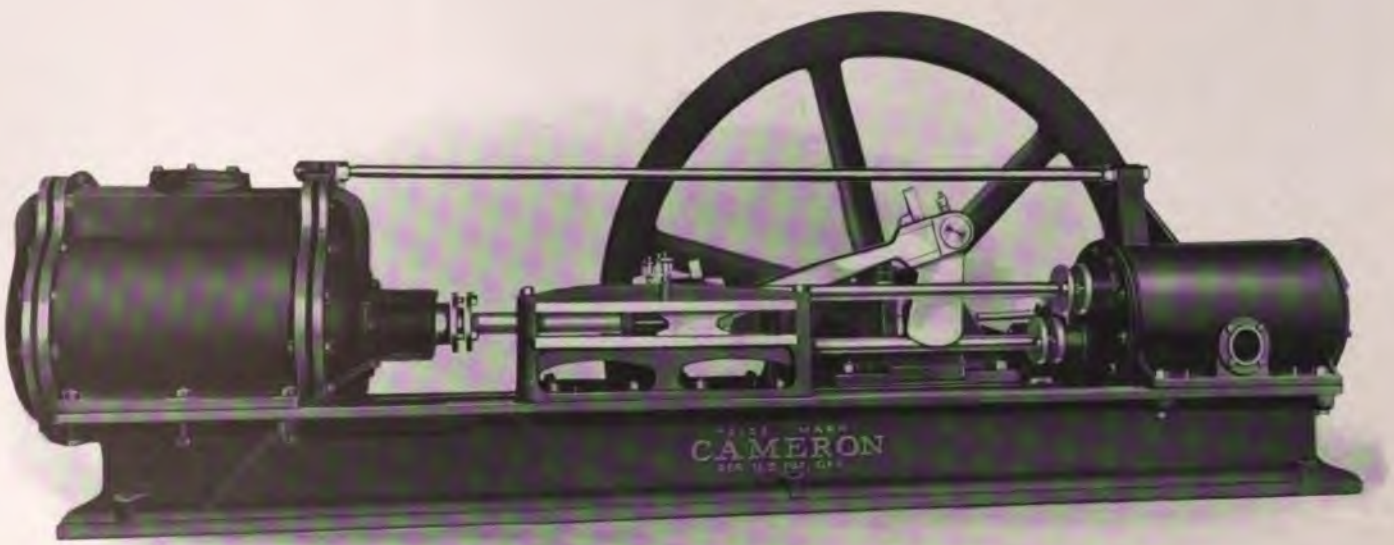
COMBINED AIR AND CIRCULATING PUMP—DIRECT-ACTING. Code word, "Aircircom"

When the vacuum cylinder is 18" diameter or over, the pattern varies from that of the small sizes. The reason for this is found in the fact that to get the liberal valve area necessary with a properly constructed machine of this character a different form of vacuum cylinder must be used.

A pump of this type should be large enough to permit of its running at a very moderate speed, and we feel justified in asserting that when our vacuum pump is properly selected for the work, no machine in the market will give more satisfactory results, and we not only endeavor to furnish a pump which will maintain a good vacuum, but one which will possess the very desirable features of durability and freedom from the necessity of frequent repairs.

The photographic reproduction illustrates size 20x22x20x24.

Code Word	Price	Diameter of Steam Cylinder Inches	Diameter of Water Cylinder Inches	Diameter of Air Cylinder Inches	Stroke of Piston, Inches	Steam Pipe	Exhaust Pipe	Suction of Water Cylinder	Discharge of Water Cylinder	Suction of Air Cylinder	Discharge of Air Cylinder	Weight
Kimito	.....	16	18	18	18	2½	4	10	10	10	10	10000
Kindberg	.....	16	18	18	24	2½	4	10	10	10	10	10630
Kinsale	.....	18	20	20	24	3	4	10	10	10	10	11550
Kiowa	.....	18	22	22	24	3	4	12	12	12	12	14900
Kirin	.....	20	24	24	24	4	5	12	12	12	12	17700

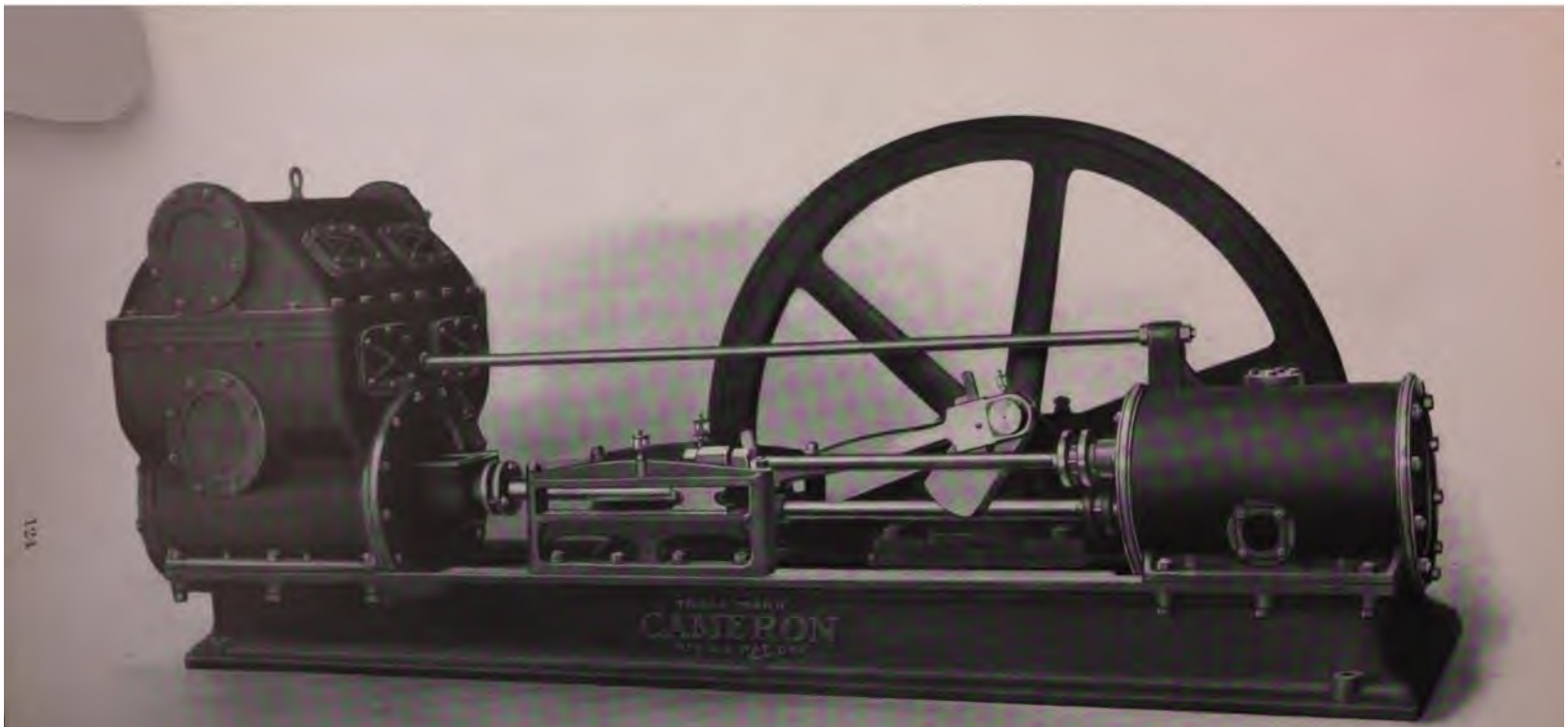


CRANK AND FLY-WHEEL DRY VACUUM PUMP. Code word, "Crankdry"

Cameron Crank and Fly-Wheel Dry Vacuum Pump

The photographic reproduction illustrates No. 8, size 18 x 24 x 24, and has long been recognized as the most perfect machine of its kind in the market, and many of the leading refineries are equipped with them because of the nearly perfect vacuum which they maintain, in many cases equaling from 28 to 30 inches of mercury. Their four valves are large rubber sheets, seating on brass plates, covering the entire ends of the vacuum cylinder. The vacuum cylinder lining, piston and rod are of the best composition.

Code Word	Price	Size Number	Diameter of Steam Cylinder, Inches	Diameter of Air Cylinder, Inches	Stroke of Piston, Inches	Weight
Maad	.....	4	10	14	14	5000
Macahe	.....	5	12	18	18	9965
Macalx	.....	6	12	20	18	11250
Macapa	.....	7	16	20	24	15236
Macpite	.....	7½	16	24	24	15500
Macra	.....	8	18	24	24	16000
Macren	.....	9	18	24	30	20660

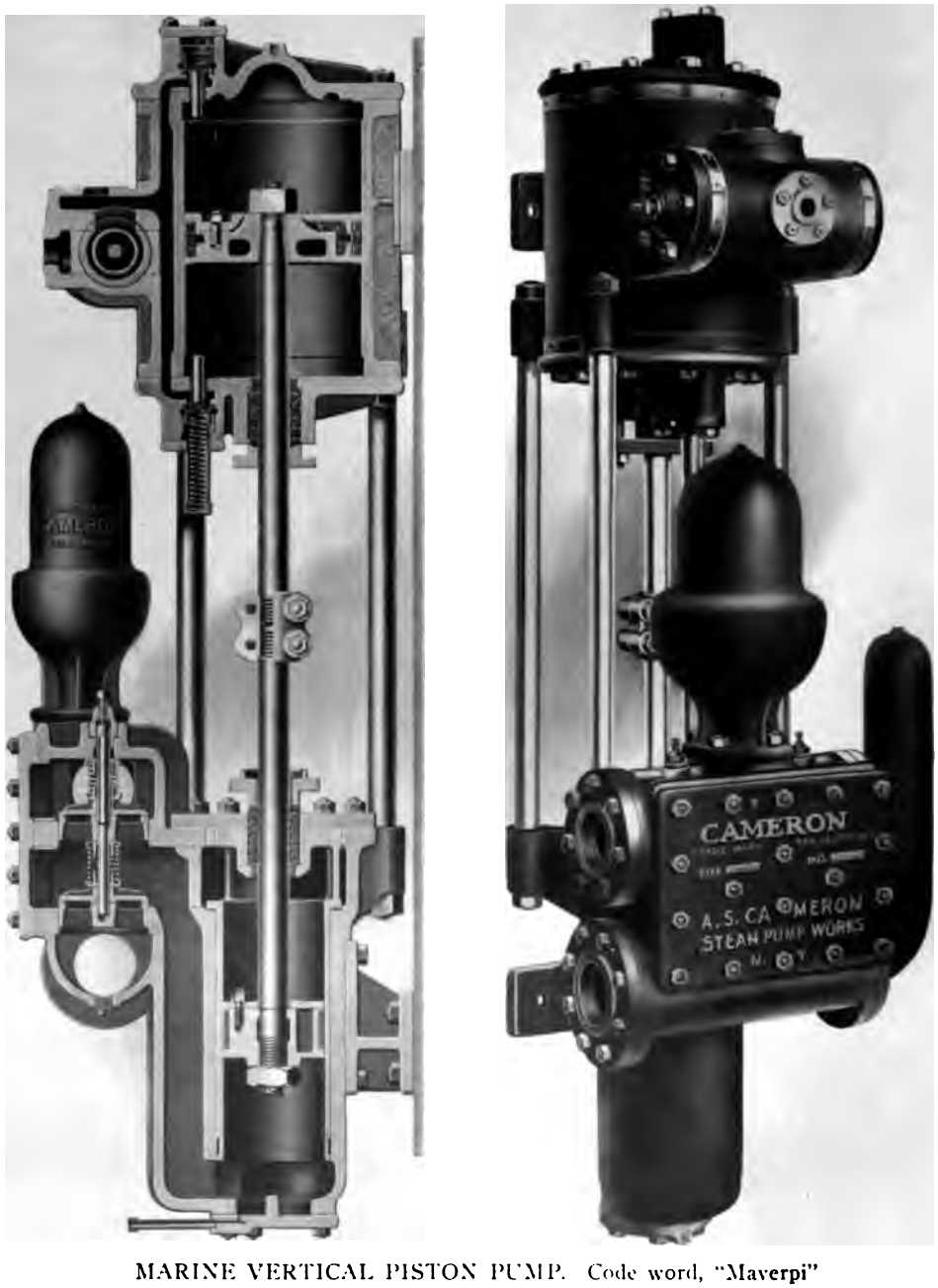


CRANK AND FLY-WHEEL WET VACUUM PUMP. Code word, "Crankwet"

Cameron Crank and Fly-Wheel Wet Vacuum Pump

The photographic reproduction illustrates size 18 x 24 x 24. This type of pump is of the same construction as the dry vacuum pump illustrated on page 122, except that the vacuum end is constructed in a similar manner to that of the direct-acting vacuum cylinder shown on page 116 and is used for the same purposes, but where a more perfect vacuum is desired.

Code Word	Price	Size Number	Diameter of Steam Cylinder, Inches	Diameter of Air Cylinder, Inches	Stroke of Piston, Inches	Weight
Meaco	.....	4	10	14	14	6000
Mearim	.....	5	12	18	18	12245
Mecosta	.....	7	16	20	24	17448
Medina	.....	8	18	24	24	20520



MARINE VERTICAL PISTON PUMP. Code word, "Maverpi"

Cameron Vertical Marine Piston Pump

THE reproductions on opposite page illustrate what we truly believe to be the very acme of perfection of pumps designed for marine use. They possess every other desirable feature combined with extreme simplicity, freedom from multiplicity of parts, and total absence of outside valve gear. No regulation of valve gear is possible or necessary, and once built, the parts cannot be changed in relation to one another or regulated in any manner whatever. They remain as constructed until worn out.

In the steam valve movement there are but three stout moving parts, viz.: two steel reversing valves operating in line with the steam piston, and one balanced piston valve which is steam driven.

The water end is of the highly esteemed CAMERON type, with its valve system, upon which the seal of approval has been placed by users in all lines of work through decades of time. These pumps are designed to work with the highest steam pressure and those recently built for the U. S. Cruisers were subjected to 500 lbs. per square inch at both steam and water ends. The steam ends are jacketed with sheet metal and brass bands over thick layers of non-conducting material, and all of the machine work reaches a high state of perfection; especial pains being taken also to insure absolutely perfect alignment.

Accessibility, a very important and indeed vital requirement in marine work particularly, has received more than usual attention. Either reversing valve, or the piston valve are rendered readily accessible by removing a single bonnet, and one bonnet also covers the water valve chest which contains all of the water valves and it is only the work of a few minutes to remove the valves, guards, stems, springs and plugs completely. The water piston may be repacked by lifting up the top cover, and the removable bushing or liner taken out by disconnecting the piston rod where it is held together by a clamp nut.

They may be arranged with bases or with brackets by which to bolt to bulkheads.

These pumps, as well as several other types described herein, are receiving the commendation of the engineers of ships of the merchant marine service, who appreciate them for the distinctive features referred to above, and because they are relieved from the watchful care and attention which pumps with complicated mechanism and multiplicity of parts constantly require.

MARINE VERTICAL PLUNGER PUMP

Code word, "Marverplun"

Cameron Vertical Marine Plunger Pump

MUCH of what has been stated on page 127 is also true of our Vertical Marine Plunger Type illustrated on the opposite page. The plunger pump is designed to meet the requirements of those who prefer this type and to overcome the objectionable features which exist in those now on the market. Although a double acting pump, it has but one stuffing box in which the plunger moves, therefore the frictional resistance is greatly diminished, and the loss of water from leakage entirely obviated.

These distinctive features may seem relatively unimportant, but they were considered under some circumstances of material consequence, having been brought to our attention by engineers of high repute, that in certain instances great pecuniary loss resulted from the leakage of fresh water in plunger pumps of the ordinary type.

VERTICAL SUCTION VALVELESS AIR PUMP

Code word, "Verilight"

Cameron Vertical Suction Valveless Air Pump

THE illustration on the opposite page shows a "CAMERON" Vertical Suction Valveless Double-acting Air Pump size 8x16x12. This pump is recommended for producing a high vacuum when connected with either surface or jet condensers. It is noiseless in operation, self-governing, will operate at any speed, and is as steady running and efficient as a fly-wheel pump without any of the complications of the latter.

It is simple and accessible in construction—occupies small space, and is very reliable in action. The steam cylinder is of the well known "CAMERON" type, with no outside valve gear, and makes a full stroke every time. The air cylinder is cast iron brass lined, and is fitted with a brass piston packed by means of water grooves. At each end of its stroke the piston uncovers an annular port at the centre of cylinder barrel, admitting air and water without any frictional resistance, and making possible the maintenance of a high vacuum.

At the return stroke the contents of the cylinder is forced out against the atmospheric pressure through the discharge valves. The pump is double-acting—the suction port is uncovered by the piston alternately above and below, and the discharge is from both top and bottom of cylinder. The discharge valves are hard rubber, re-enforced with a composition backing plate or guard and are held against the seats by spiral springs.

The valve studs extend through the covers and are locked with set screw and cap nut, and cannot possibly get adrift. The steam cylinder is lagged with Russia iron; the tee bars are polished, and the whole pump has a neat and workmanlike appearance.

This type of pump is without suction valves and very simple in construction and as light as possible in weight. It is particularly adapted for use on steam yachts, light draft vessels and torpedo boats, for it may be built extremely light and having very few parts it is nevertheless competent to produce a very high vacuum. Ordinarily it is rated at a comparatively low piston speed, but its construction is such that it may be run at quite a high speed when an unusual condition prevails and it becomes necessary to increase the horse power of the engines.

It, however, should not be used except where the suction may be on a level with or below the condenser connection.

When built for marine work it is called The Cameron "Verilight."

TWIN BEAM AIR PUMP—MARINE TYPE

Code word, "Twinbeam"

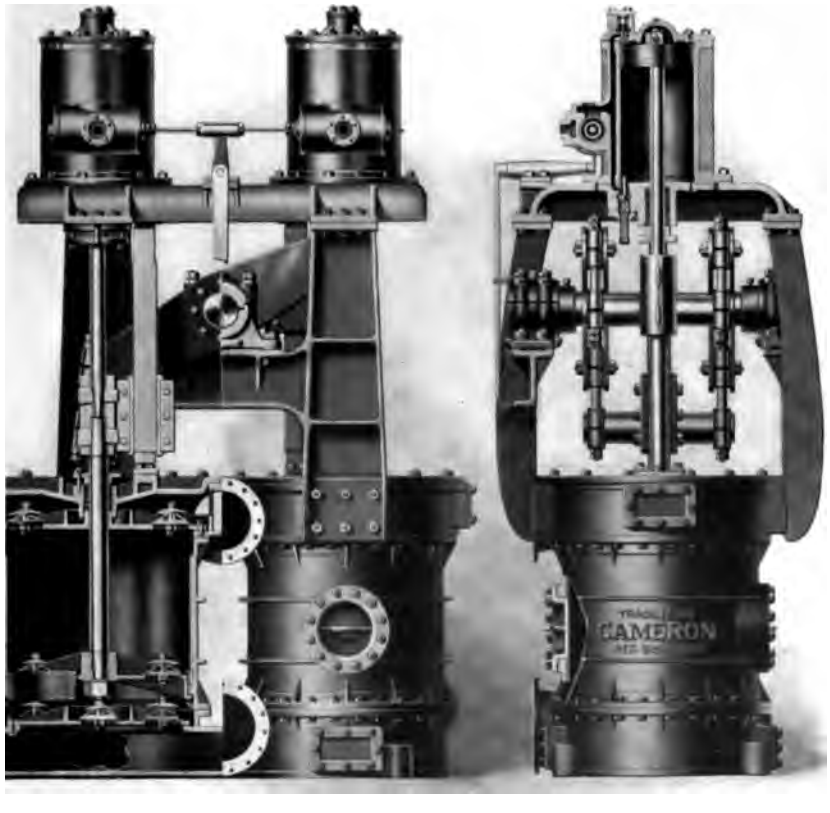
ameron Twin Beam Air Pump

The pump, which is illustrated below and on the opposite page, embodies in its gn and construction all the better features which are the result of practical exence and of the best obtainable knowledge of engineering practice in the buildof this class of machine.

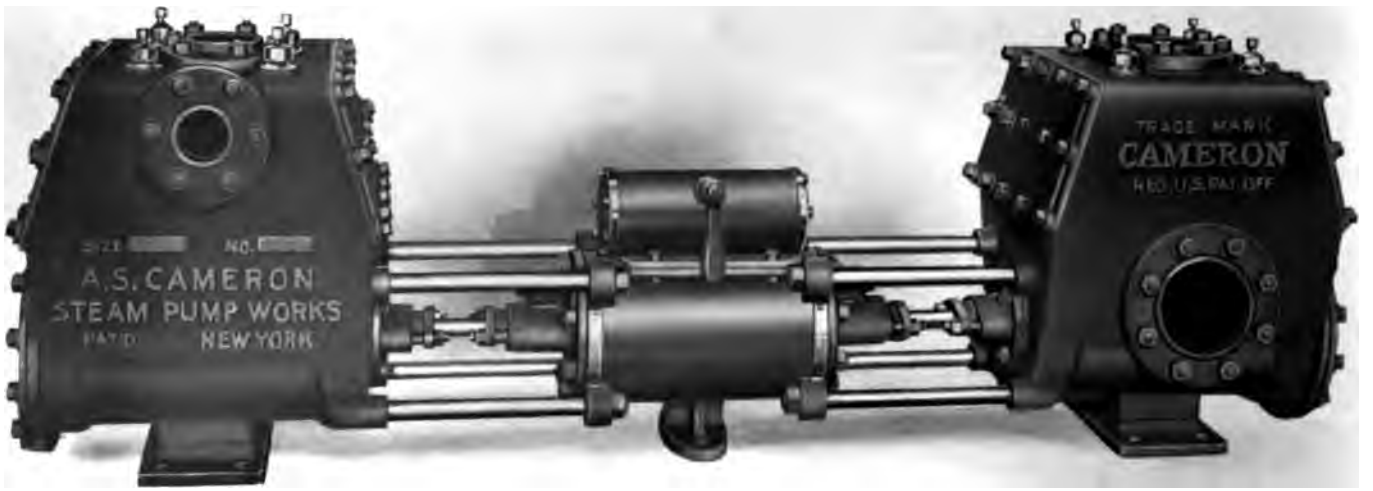
The above pertains to the general character of the pump, but when it is conred that the CAMERON improved high steam pressure valve-gear consisting in entirety of only three moving pieces to each cylinder, is a part of it, a better reciation of its superior merit is obtained. The parts of this valve gear are all de, as per sectional view below, and described on page 127. Having furnished v York's Municipal ferry boats with pumps of this type of our latest design, these having given complete satisfaction, we feel justified in asserting that they unqualifiedly the best on the market. We have spared no effort in our attempt)roduce an apparatus perfect in every way, and we feel that their success warts our claims and justifies our assertions.

Those we built for the U. S. Cruisers, and of the size 14 x 35 x 18, work equally l and are lacking in no detail necessary to their perfection of construction and ration.

Complete specifications will be forwarded to anyone interested.



SECTIONAL VIEW OF TWIN BEAM AIR PUMP



COMBINED AIR AND CIRCULATING PUMP FOR HIGH STEAM PRESSURES

Code word, "Histeamair"

Cameron Combined Air and Circulating Pump
For High Steam Pressures

BEING designed to be used in connection with a surface condenser, the suction of the air end and the discharge of the water end are on the top. This arrangement lends itself to a ready and convenient application to the condenser, the openings of which are frequently placed at the bottom; thus straight connections may be made and the condenser may be supported over the pump.

The valves and seats of both ends of this pump are prevented from getting loose by the application of the CAMERON pump-end principle, which provides for the valve-stems extending from the top surface through the upper valves and into the lower valve seats.

Plugs at the top permit of their being readily withdrawn, thus releasing the valves and springs, which may then be quickly removed if desired, by simply taking off the bonnets.

DETAILS OF CAMERON REGULAR AND BOILER FEED PUMPS

List of Details of Cameron Regular and Boiler Feed Pumps

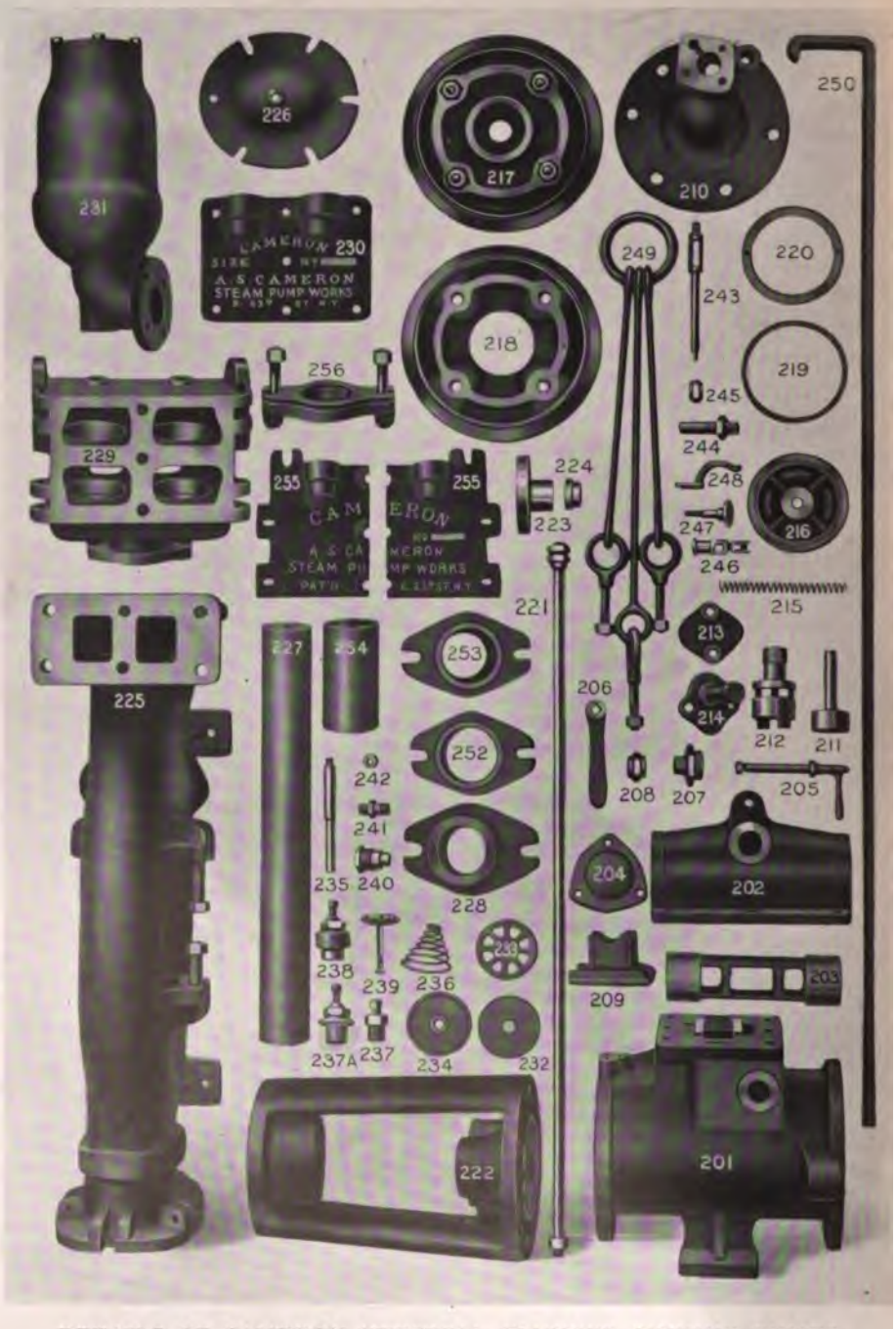
In Ordering Parts:

1. Give *size number,* which will be found cast on valve chest bonnet.

2. Give *shop number,* which will be found stamped on valve chest bonnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

Part No.	Code Word	Parts
101	**Pabba**	Steam cylinder for sizes 0 to 4a.
102	**Pacaja**	Steam chest for sizes 0 to 4a.
103	**Pacheco**	Steam chest plunger.
104	**Pacora**	Steam chest cover for sizes 0 to 4a.
105	**Pactolus**	Steam chest crank and nut.
106	**Paderno**	Steam chest crank handle.
107	**Padula**	Steam chest,stuffing boxbottom
108	**Pahang**	Steam chest, stuffing box cap.
109	**Pakwan**	Slide valve.
110	**Palacios**	Steam cylinder cover.
111	**Palaur**	Reversing valve.
112	**Palisse**	Reversing valve bushing.
113	**Pallo**	Reversing valve cap for sizes 5 to 12.
114	**Palmas**	Reversing valve plug for sizes 0 to 4a.
115	**Palmetto**	Steam piston head for sizes 0 to 4a, old style.
116	**Palmoli**	Steam piston head, sizes 0 to 9, new style, with taper hole.
116a	**Palmstoron**	Steam piston follower, sizes 0 to 9, new style, straight hole.
117	**Paloan**	Steam piston head for sizes 10a to 12, and larger.
118	**Palota**	Steam piston follower, sizes 0 to 4a, old style.
119	**Pamir**	Steam piston follower, sizes 10a to 12, and larger.
120	**Pampatar**	Steam piston packing ring, with wedge and spring, for sizes 0 to 4a, old style.
121	**Panaila**	Steam piston packing ring for sizes 0 to 12, new style.
122	**Panario**	Steam piston bull ring for sizes 0 to 12, new style.
123	**Pancova**	Piston rod and nuts.
124	**Panduah**	Body piece for sizes 0 to 4a.
125	**Panguitch**	Piston rod, stuffing box gland.
126	**Panjab**	Piston rod,stuffing box bottom.
127	**Panormos**	Piston rod, stuffing box cap.
128	**Pantego**	Piston rod, stuffing box thimble
129	**Pantura**	Water cylinder for sizes 0 to 4a.
130	**Paragau**	Water cylinder cover for sizes 0 to 4a.
131	**Paraje**	Water cylinder bonnet.
132	**Paramatta**	Water piston head for sizes 0 to 10a.
133	**Parazatu**	Water piston head for sizes 10 to 12.
134	**Parecis**	Water piston follower for sizes 0 to 10a.
135	**Parida**	Water piston follower for sizes 10 to 12.
136	**Parma**	Water valve, suction or discharge?
137	**Partello**	Water valve seat, suction or discharge?
138	**Parvich**	Water valve guard, suction or discharge?
139	**Pascack**	Water valve stem.
140	**Pascuaro**	Water valve spring, suction or discharge?
141	**Paspebiac**	Water valve stem plug for sizes 0 to 6.
141a	**Paspit**	Water valve stem plug for sizes 5b to 10a.
142	**Pastena**	Water valve stem plug for sizes 10 to 12.
143	**Pataula**	Air chamber.
144	**Patebad**	Steam cylinder for sizes 5 to 12.
145	**Patebalos**	Steam chest for sizes 5 to 12.
146	**Patebalug**	Steam chest cover for sizes 5 to 12.
147	**Patebalurk**	Body piece for sizes 5 to 12.
148	**Patebamig**	Water cylinder for sizes 5 to 12.
149	**Patebamur**	Water cylinder cover for sizes 5 to 12, round or oval.
150	**Patebaol**	Discharge neck, with flange, for sizes 10 and larger.
151	**Patebapim**	Water cylinder lining.
152	**Patebaqu**	Removable bushing.



DETAILS OF CAMERON VERTICAL PLUNGER SINKING PUMPS

List of Details of Cameron Vertical Plunger Sinking Pumps

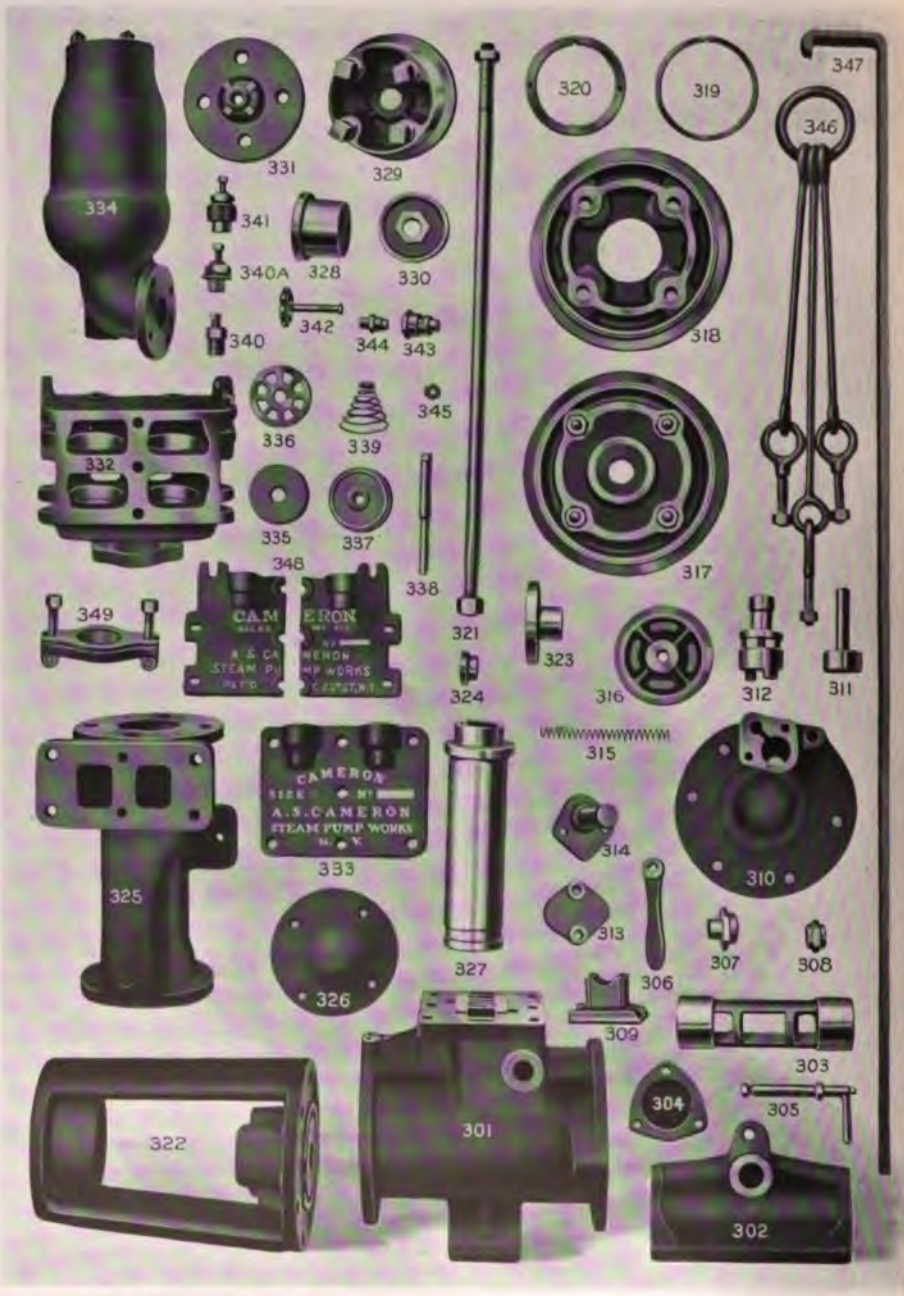
In Ordering Parts:

1. Give *size number,* which will be found cast on valve chest bonnet.

2. Give *shop number,* which will be found stamped on valve chest bonnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

Part No.	Code Word	Parts
201	**Peage**	Steam cylinder.
202	**Peccioli**	Steam chest.
203	**Pecetto**	Steam chest plunger.
204	**Pechina**	Steam chest cover.
205	**Pecs**	Steam chest crank and nut.
206	**Pedir**	Steam chest crank handle.
207	**Pedroso**	Steam chest, stuffing box bottom
208	**Peene**	Steam chest, stuffing box cap.
209	**Peilan**	Slide valve.
210	**Peitz**	Steam cylinder cover.
211	**Pella**	Reversing valve.
212	**Pelotas**	Reversing valve bushing.
213	**Pelusium**	Reversing valve cap—top.
214	**Pemba**	Reversing valve cap, with pipe —bottom.
215	**Pencum**	Reversing valve spring.
216	**Penedo**	Steam piston head for sizes 5 to 9a,—the head has a taper hole
216a	**Penfield**	Steam piston follower for sizes 5 to 9a. Follower has straight hole.
217	**Penha**	Steam piston head for sizes 9b to 12, and larger.
218	**Penmarch**	Steam piston follower for sizes 10 to 12, and larger.
219	**Peensburg**	Steam piston packing ring.
220	**Penpont**	Steam piston bull ring.
221	**Penvenan**	Piston rod with nuts.
222	**Pera**	Body piece.
223	**Perasto**	Piston rod, stuffing box gland.
224	**Perche**	Piston rod, stuffing box thimble
225	**Pereira**	Water cylinder barrel, with gland bolts.
226	**Perello**	Water cylinder cover.
227	**Pergamus**	Water plunger.
228	**Pergola**	Water plunger gland (for pumps *without casing.*)
229	**Perinaldo**	Water valve chest.
230	**Perkasie**	Water valve chest bonnet, one part.
231	**Perlak**	Air chamber, with discharge flange.
232	**Perlepe**	Water valve.
233	**Pernagoa**	Water valve seat, suction or discharge?
234	**Pernau**	Water valve guard, suction or discharge?
235	**Perouse**	Water valve stem.
236	**Perrot**	Water valve spring, suction or discharge?
237	**Perserin**	Water valve stem plug for sizes 5 to 6.
237a	**Persato**	Water valve stem plug for sizes 7 to 9b.
238	**Persifer**	Water valve stem plug for sizes 10 to 12.
239	**Pertuis**	Priming valve with hand-wheel
240	**Perugia**	Priming valve body.
241	**Peruwels**	Priming valve, stuffing box bottom.
242	**Pervyse**	Priming valve, stuffing box cap
243	**Pesaro**	Exhaust cut-off valve.
244	**Pescina**	Exhaust cut-off, stuffing box bottom.
245	**Peshtigo**	Exhaust cut-off, stuffing box cap.
246	**Pesotum**	Exhaust cut-off lever.
247	**Petaluma**	Exhaust cut-off handle.
248	**Peteghem**	Exhaust cut-off quadrant.
249	**Petite**	Slings.
250	**Petrella**	Hooks.
252	**Petremast**	Water plunger lower gland, for "casing" type.
253	**Petremint**	Water plunger upper gland, for "casing" type.
254	**Petremix**	Water plunger casing.
255	**Petremock**	Water valve chest bonnet, two parts.
256	**Petremoft**	Suction flange, with swing bolts.



DETAILS OF VERTICAL PISTON SINKING PUMPS

ist of Details of Cameron ertical Piston Sinking Pump

In Ordering Parts:

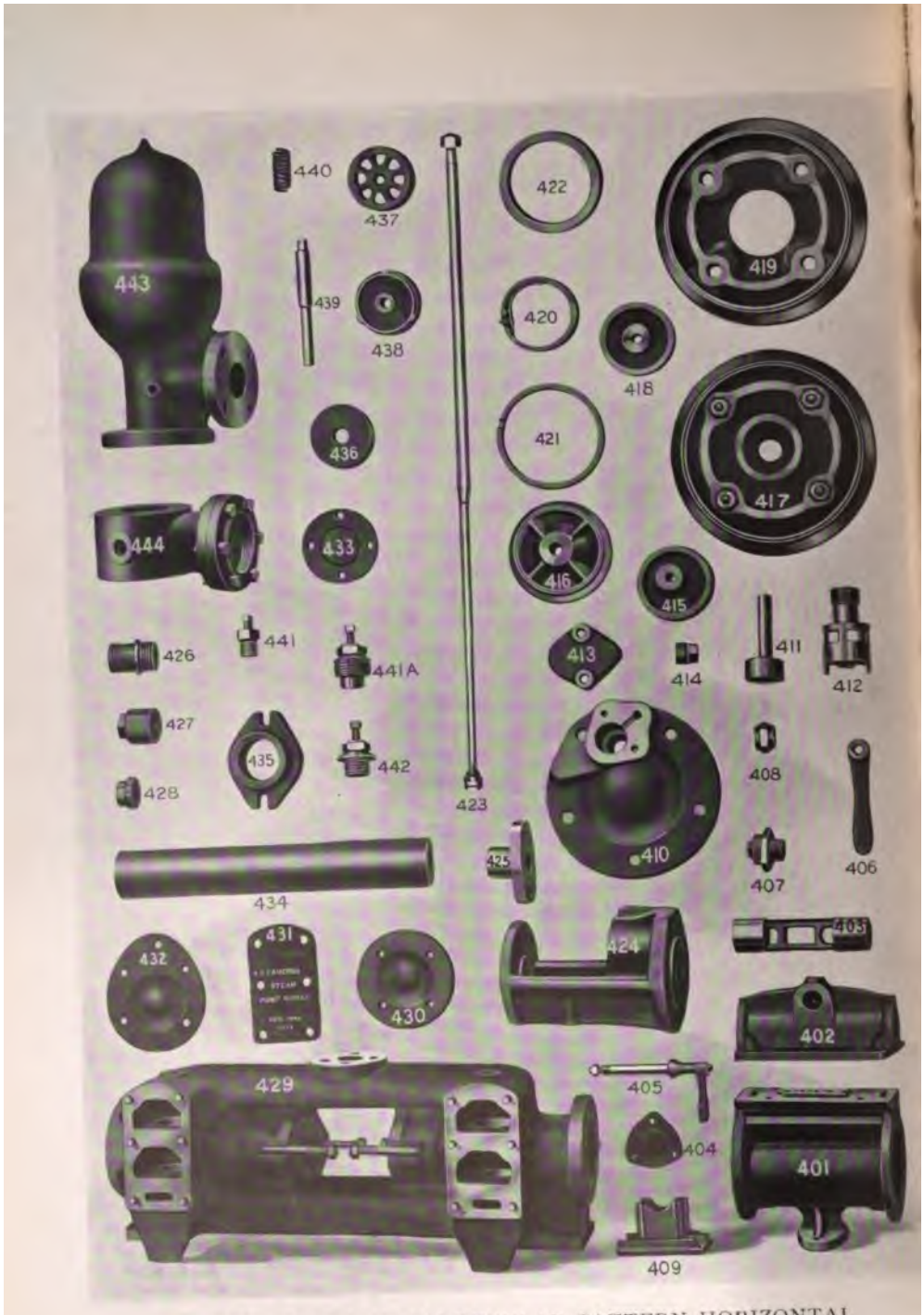
1. Give *size number,* which will be found cast on valve chest onnet.

2. Give *shop number,* which will be found stamped on valve chest onnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

rt o.	Code Word	Parts
1	**Piacenza**	Steam cylinder.
2	**Pianella**	Steam chest.
3	**Pianfei**	Steam chest plunger.
4	**Piasco**	Steam chest cover.
5	**Piave**	Steam chest crank and nut.
6	**Picacho**	Steam chest crank handle.
7	**Picerno**	Steam chest, stuffing box bottom.
8	**Picton**	Steam chest, stuffing box cap.
9	**Pidjan**	Slide valve.
0	**Pielis**	Steam cylinder cover.
1	**Pietole**	Reversing valve.
2	**Pilkallen**	Reversing valve bushing.
3	**Pinaleno**	Reversing valve cap—top.
4	**Pincon**	Reversing valve cap, with pipe —bottom.
5	**Pinega**	Reversing valve spring.
6	**Pinne**	Steam piston head, sizes 5 to 9; the head has a *taper* hole.
6a	**Pinsk**	Steam piston follower, sizes 5 to 9, follower has a *straight* hole.
7	**Pintia**	Steam piston head, sizes 10 and larger.
8	**Pinzon**	Steam piston follower, sizes 10 and larger.
9	**Piopolis**	Steam piston packing ring.
0	**Pipaix**	Steam piston bull ring.
1	**Pipriac**	Piston rod, with nuts.
2	**Pirahi**	Body piece.
3	**Piritu**	Piston rod, stuffing box gland.
4	**Pirnitz**	Piston rod, stuffing box thimble
5	**Pirputta**	Water cylinder barrel.
6	**Pisania**	Water cylinder cover.
7	**Pisaurus**	Water cylinder removable bushing.

Part No.	Code Word	Parts
328	**Piscopi**	Water piston head, sizes 5 to 9.
329	**Pisek**	Water piston head, with bolts, sizes 10 and larger.
330	**Pisticci**	Water piston follower, sizes 5 to 9.
331	**Pistoja**	Water piston follower, sizes 10 and larger.
332	**Pistolet**	Water valve chest.
333	**Pitcairn**	Water valve bonnet (one part.)
334	**Piteglio**	Air chamber, with discharge flange.
335	**Piti**	Water valve.
336	**Pitland**	Water valve seat, suction or discharge?
337	**Pitzthal**	Water valve guard, suction or discharge?
338	**Piverone**	Water valve stem.
339	**Pizarra**	Water valve spring, suction or discharge?
340	**Pizzo**	Water valve stem plug for sizes 5 and 6.
340a	**Pizzuabb**	Water valve stem plug for sizes 7 to 9.
341	**Planier**	Water valve stem plug for sizes 10 and larger.
342	**Plaski**	Priming valve, with hand-wheel.
343	**Platana**	Priming valve body.
344	**Platz**	Priming valve, stuffing box bottom.
345	**Plauen**	Priming valve, stuffing box cap
346	**Plauzat**	Slings.
347	**Plavis**	Hooks.
348	**Plarodd**	Water valve bonnet, *two pieces.*
349	**Plavoger**	Suction flange with swing bolts.



DETAILS OF CAMERON REGULAR PATTERN HORIZONTAL PLUNGER PUMPS

List of Details of Cameron Horizontal Plunger Pump — Regular Pattern

In Ordering Parts:

1. Give *size number,* which will be found cast on valve chest bonnet.

2. Give *shop number,* which will be found stamped on valve chest bonnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

Part No.	Code Word	Parts
401	**Pleau**	Steam cylinder.
402	**Plelo**	Steam chest.
403	**Plesis**	Steam chest plunger.
404	**Plestin**	Steam chest cover.
405	**Plevna**	Steam chest crank and nut.
406	**Pliego**	Steam chest crank handle.
407	**Ploen**	Steam chest, stuffing box bottom.
408	**Plonsk**	Steam chest, stuffing box cap.
409	**Plouay**	Slide valve.
410	**Plourin**	Steam cylinder cover.
411	**Poage**	Reversing valve.
412	**Poblat**	Reversing valve bushing.
413	**Pocone**	Reversing valve cap for 7x3½x12 and larger.
414	**Podbrad**	Reversing valve plug for sizes A, B and B-B.
415	**Podgora**	Steam piston head for sizes A, B and B-B, old style.
416	**Podolia**	Steam piston head for sizes with steam cylinders 4″ to 12″ dia. The head has a taper hole.
416a	**Poheta**	Steam piston follower for sizes with steam cylinder, 4″ to 12″ dia. The follower has a straight hole.
417	**Poinset**	Steam piston head for sizes with steam cylinders 14″ dia. and larger.
418	**Poitou**	Steam piston follower for sizes A, B and B-B, old style.
419	**Pokona**	Steam piston follower for sizes with steam cylinders 14″ dia. and larger.
420	**Polia**	Steam piston packing ring, with wedge and spring for sizes A, B and B-B, old style.
421	**Pollina**	Steam piston packing ring for sizes with steam cylinders 4″ dia. and larger.
422	**Pollone**	Steam piston bull ring for sizes with steam cylinders 4″ dia. or larger.
423	**Poltava**	Piston rod and nuts.
424	**Pomata**	Body piece.
425	**Pombal**	Piston rod, stuffing box gland.
426	**Pomfret**	Piston rod, stuffing box bottom
427	**Pomona**	Piston rod, stuffing box cap.
428	**Pongas**	Piston rod, stuffing box thimble.
429	**Ponany**	Water cylinder.
430	**Ponorgo**	Water cylinder cover (round shape).
431	**Pontita**	Water cylinder bonnet.
432	**Popoli**	Water cylinder cover (oval shape).
433	**Poprad**	Blank suction flange.
434	**Porcia**	Water plunger.
435	**Poreta**	Water plunger gland.
436	**Pornic**	Water valve.
437	**Portil**	Water valve seat, suction or discharge?
438	**Potosi**	Water valve guard, suction or discharge?
439	**Powis**	Water valve stem.
440	**Pownal**	Water valve spring, suction or discharge?
441	**Poyais**	Water valve stem plug for sizes A to C.
441a	**Poyask**	Water valve stem plug for sizes D to 18x7x18.
442	**Poygan**	Water valve stem plug for sizes F and larger.
443	**Poyner**	Air chamber.
444	**Poyman**	Discharge neck and flange.

Useful Information—Steam

A cubic inch of water evaporated under atmospheric pressure is approximately converted into 1 cubic foot of steam.

The horse power of boilers, as per standard adopted by the Am. S. M. E., is 30 pounds water evaporated per hour at a pressure of 70 pounds per square inch and from a temperature of 100 degrees Fahr.

Well designed boilers, under successful operation, will evaporate from 7 to 10 pounds of water per pound of first-class coal.

Each square foot of heating surface is considered sufficient to evaporate 2 pounds of water; therefore an engine using 30 pounds of water per horse power per hour, each horse power of the engine requires 15 square feet heating surface in the boiler.

On one square foot of fire grate can be burned on an average from 10 to 12 pounds hard coal, or 18 to 20 pounds soft coal, per hour, with natural draft.

Two and one-quarter pounds of dry wood is equal to 1 pound of average quality soft coal.

Steam engines consume from 12 to 50 pounds of feed water, and from 1¼ to 7 pounds of coal, per hour per indicated horse power.

Condensing engines require from 20 to 30 times the amount of feed water for condensing purposes; approximately for most engines, 1 to 1½ gallons condensing water per minute per indicated horse power.

Surface condensers for compound steam engines require about 2 square feet of cooling surface per horse power; ordinary engines will require more surface according to their economy in the use of steam. It is absolutely necessary that the air pump should be set lower than the condenser for satisfactory results.

The effect of a good air pump and condenser should be to get 25 inches of vacuum and to make available about 10 pounds more mean effective pressure with the same terminal pressure, or to give the same mean effective pressure with a correspondingly less terminal pressure. Approximately, a good condenser will save one-fourth of the fuel consumed, or, in other words, increase the power of the engine one-fourth, the fuel consumption remaining the same.

One cubic inch weighs .0361 pounds.

One pound = 27.7 cubic inches.

One cubic foot = 62.4245 pounds at 39 degrees Fahr.; 7.48 gallons U. S.; 6.2321 gallons imperial.

One gallon U. S. = 8.33111 pounds; 231 cubic inches; .13368 cubic feet.

One imperial gallon = 10 pounds at 62 degrees Fahr.; 277.274 cubic inches; .16046 cubic feet.

One pound pressure = 2.31 feet in height.

One foot in height = .433 pounds pressure.

Petroleum weighs 6½ pounds per U. S. gallon, 42 gallons to the barrel.

To convert imperial gallons into U. S. gallons, multiply by the factor 1.2. To convert U. S. gallons into imperial gallons, multiply by the factor .8333.

A miner's inch is a measure for flow of water, and is the quantity of water that will flow in one minute through an opening one inch square in a plank 2 inches thick under a head of 6½ inches to the centre of the orifice. This is equivalent, approximately, to 1.53 cubic feet, or 11½ gallons per minute.

To find the diameter of pump plungers to pump a given quantity of water at 100 feet piston speed per minute, divide the number of gallons by 4, then extract the square root, and the result will be the diameter in inches of the plungers.

To find the number of gallons delivered per minute by a single double-acting pump at 100 feet piston speed per minute, square the diameters of the plungers, then multiply by 4.

To find the horse power necessary to elevate water to a given height, multiply the weight of the water elevated per minute by the height in feet and divide the product by 33,000 (an allowance should be made for water friction and a further allowance for losses in the steam cylinder, say from 20 to 30 per cent.).

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inches, or a column of water 33.9 feet high at sea level.

To determine the proportion between the steam and pump cylinder, multiply the given area of the pump cylinder by the resistance on the pump in pounds per square inch, and divide the product by the available pressure of steam in pounds per square inch. The product equals the area of the steam cylinder. To this must be added an extra area to overcome the friction, which is usually taken at 25 per cent.

The resistance of friction in the flow of water through pipes of uniform diameter is independent of the pressure and increases *directly* as the length and the square of the velocity of the flow, and *inversely* as the diameter of the pipe. With wooden pipes the friction is 1.75 times greater than in metallic. Doubling the diameter increases the capacity four times.

To determine the velocity in feet per minute necessary to discharge a given volume of water in a given time, multiply the number of cubic feet of water by 144 and divide the product by the area of the pipe in inches.

To determine the area of a required pipe, the volume and velocity of water being given, multiply the number of cubic feet of water by 144 and divide the product by the velocity in feet per minute.

Pressure of Water

The pressure of water in pounds per square inch for every foot in height to 260 feet; and then, by intervals, to 3,000 feet head. By this table, from the pounds pressure per square inch, the feet head is readily obtained, and *vice versa*.

Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch
1	0.43	54	23.39	107	46.34	160	69.31	213	92.20	285	123.45
2	0.86	55	23.82	108	46.78	161	69.74	214	92.69	290	125.62
3	1.30	56	24.26	109	47.21	162	70.17	215	93.13	295	127.78
4	1.73	57	24.69	110	47.64	163	70.61	216	93.56	300	129.95
5	2.16	58	25.12	111	48.08	164	71.04	217	93.99	305	132.12
6	2.59	59	25.55	112	48.51	165	71.47	218	94.43	310	134.28
7	3.03	60	25.99	113	48.94	166	71.91	219	94.86	315	136.46
8	3.46	61	26.42	114	49.38	167	72.34	220	95.30	320	138.62
9	3.89	62	26.85	115	49.81	168	72.77	221	95.73	325	140.79
10	4.33	63	27.29	116	50.24	169	73.20	222	96.16	330	142.95
11	4.76	64	27.72	117	50.68	170	73.64	223	96.60	335	145.12
12	5.20	65	28.15	118	51.11	171	74.07	224	97.03	340	147.28
13	5.63	66	28.58	119	51.54	172	74.50	225	97.46	345	149.45
14	6.06	67	29.02	120	51.98	173	74.94	226	97.90	350	151.61
15	6.49	68	29.45	121	52.41	174	75.37	227	98.33	355	153.78
16	6.93	69	29.88	122	52.84	175	75.80	228	98.76	360	155.94
17	7.36	70	30.32	123	53.28	176	76.23	229	99.20	365	158.10
18	7.79	71	30.75	124	53.71	177	76.67	230	99.63	370	160.27
19	8.22	72	31.18	125	54.15	178	77.10	231	100.0	375	162.45
20	8.66	73	31.62	126	54.58	179	77.53	232	100.49	380	164.61
21	9.09	74	32.05	127	55.01	180	77.97	233	100.93	385	166.78
22	9.53	75	32.48	128	55.44	181	78.40	234	101.36	390	168.94
23	9.96	76	32.92	129	55.88	182	78.84	235	101.70	395	171.11
24	10.39	77	33.35	130	56.31	183	79.27	236	102.23	400	173.27
25	10.82	78	33.78	131	56.74	184	79.70	237	102.66	425	184.10
26	11.26	79	34.21	132	57.18	185	80.14	238	103.09	450	195.0
27	11.69	80	34.65	133	57.61	186	80.57	239	103.53	475	205.77
28	12.12	81	35.08	134	58.04	187	81.0	240	103.96	500	216.58
29	12.55	82	35.52	135	58.48	188	81.43	241	104.39	525	227.42
30	12.99	83	35.95	136	58.91	189	81.87	242	104.83	550	238.25
31	13.42	84	36.39	127	59.34	190	82.30	243	105.26	575	249.09
32	13.86	85	36.82	138	59.77	191	82.73	244	105.69	600	259.90
33	14.29	86	37.25	139	60.21	192	83.17	245	106.13	625	270.73
34	14.72	87	37.68	140	60.64	193	83.60	246	106.56	650	281.56
35	15.16	88	38.12	141	61.07	194	84.03	247	106.99	675	292.40
36	15.59	89	38.55	142	61.51	195	84.47	248	107.43	700	303.22
37	16.02	90	38.98	143	61.94	196	84.90	249	107.86	725	314.05
38	16.45	91	39.42	144	62.37	197	85.33	250	108.29	750	324.88
39	16.89	92	39.85	145	62.81	198	85.76	251	108.73	775	335.72
40	17.32	93	40.28	146	63.24	199	86.20	252	109.16	800	346.54
41	17.75	94	40.72	147	63.67	200	86.63	253	109.59	825	357.37
42	18.19	95	41.15	148	64.10	201	87.07	254	110.03	850	368.20
43	18.62	96	41.58	149	64.54	202	87.50	255	110.46	875	379.03
44	19.05	97	42.01	150	64.97	203	87.93	256	110.89	900	389.86
45	19.49	98	42.45	151	65.40	204	88.36	257	111.32	925	400.70
46	19.92	99	42.88	152	65.84	205	88.80	258	111.76	950	411.54
47	20.35	100	43.31	153	66.27	206	89.21	259	112.19	975	422.35
48	20.79	101	43.75	154	66.70	207	89.66	260	112.62	1000	433.18
49	21.22	102	44.18	155	67.14	208	90.10	261	113.06	1500	649.7
50	21.65	103	44.61	156	67.57	209	90.53	262	113.49	2000	866.3
51	22.09	104	45.05	157	68.0	210	90.96	270	116.96	3000	1,299.5
52	22.52	105	45.48	158	68.43	211	91.39	275	119.12		
53	22.95	106	45.91	159	68.87	212	91.83	280	121.29		

Areas of Circles, Advancing by Eighths

AREAS

Diam	0	⅛	¼	⅜	½	⅝	¾	⅞
0	.0	.0123	.0491	.1105	.1964	.3068	.4418	.6013
1	.7854	.9940	1.2272	1.4849	1.7671	2.0739	2.4053	2.7612
2	3.14	3.55	3.98	4.43	4.91	5.41	5.94	6.49
3	7.07	7.67	8.30	8.95	9.62	10.32	11.05	11.79
4	12.57	13.36	14.19	15.03	15.90	16.80	17.72	18.67
5	19.64	20.63	21.65	22.69	23.76	24.85	25.97	27.11
6	28.27	29.47	30.68	31.92	33.18	34.47	35.79	37.12
7	38.49	39.87	41.28	42.72	44.18	45.66	47.17	48.71
8	50.27	51.85	53.46	55.09	56.75	58.43	60.13	61.86
9	63.62	65.40	67.20	69.03	70.88	72.76	74.66	76.59
10	78.54	80.52	82.52	84.54	86.59	88.66	90.76	92.89
11	95.03	97.21	99.40	101.62	103.87	106.14	108.43	110.75
12	113.10	115.47	117.86	120.28	122.72	125.19	127.68	130.19
13	132.73	135.30	137.89	140.50	143.14	145.80	148.49	151.20
14	153.94	156.70	159.48	162.30	165.13	167.99	170.87	173.78
15	176.71	179.67	182.65	185.66	188.69	191.75	194.83	197.93
16	201.06	204.22	207.39	210.60	213.82	217.08	220.35	223.65
17	226.98	230.33	233.71	237.10	240.53	243.98	247.45	250.95
18	254.47	258.02	261.59	265.18	268.80	272.45	276.12	279.81
19	283.53	287.27	291.04	294.83	298.65	302.49	306.35	310.24
20	314.16	318.10	322.06	326.05	330.06	334.10	338.16	342.25
21	346.36	350.50	354.66	358.84	363.05	367.28	371.54	375.83
22	380.13	384.46	388.82	393.20	397.61	402.04	406.49	410.97
23	415.48	420.00	424.56	429.13	433.74	438.36	443.01	447.69
24	452.39	457.11	461.86	466.64	471.44	476.26	481.11	485.98
25	490.87	495.79	500.74	505.71	510.71	515.72	520.77	525.84
26	530.93	536.05	541.19	546.35	551.55	556.76	562.00	567.27
27	572.56	577.87	583.21	588.57	593.96	599.37	604.81	610.27
28	615.75	621.26	626.80	632.36	637.94	643 55	649.18	654.84
29	660.52	666.23	671.96	677.71	683.49	689.30	695.13	700.98
30	706.86	712.76	718.69	724.64	730.62	736.62	742.64	748.69
31	754.77	760.87	766.99	773.14	779.31	785.51	791.73	797.98
32	804.25	810.54	816.86	823.21	829.58	835.97	842.39	848.83
33	855.30	861.79	868.31	874.85	881.41	888.00	894.62	901.26
34	907.92	914.61	921.32	928.06	934.82	941.61	948.42	955.25
35	962.11	969.00	975.91	982.84	989.80	996.78	1003.8	1010.8
36	1017.9	1025.0	1032.1	1039.2	1046.3	1053.5	1060.7	1068.0
37	1075.2	1082.5	1089.8	1097.1	1104.5	1111.8	1119.2	1126.7
38	1134.1	1141.6	1149.01	1156.6	1164.2	1171.7	1179.3	1186.9
39	1194.6	1202.3	1210.0	1217.7	1225.4	1233.2	1241.0	1248.8
40	1256.6	1264.5	1272.4	1280.3	1288.2	1296.2	1304.2	1312.2
41	1320.3	1328.3	1336.4	1344.5	1352.7	1360.8	1369.0	1377.2
42	1385.4	1393.7	1402.0	1410.3	1418.6	1427.0	1435.4	1443.8
43	1452.2	1460.7	1469.1	1477.6	1486.2	1494.7	1503.3	1511.9
44	1520.5	1529.2	1537.9	1546.6	1555.3	1564.0	1572.8	1581.6
45	1590.4	1599.3	1608.2	1617.0	1626.0	1634.9	1643.9	1652.9
46	1661.9	1670.9	1680.0	1689.1	1698.2	1707.4	1716.5	1725.7
47	1734.9	1744.2	1753.5	1762.7	1772.1	1781.4	1790.8	1800.1
48	1809.6	1819.0	1828.5	1837.9	1847.5	1857.0	1866.5	1876.1
49	1885.7	1895.4	1905.0	1914.7	1924.4	1934.2	1943.9	1953.7
50	1963.5	1973.3	1983.2	1993.1	2203.0	2012.9	2022.8	2032.8

Table Giving Ratios of Areas

For given diameters of steam and water cylinders.

Diameter of Water Cylinders	DIAMETER OF STEAM CYLINDERS										
	3	3½	4	5	6	7	8	9	10	12	14
⅝	23.04	31.36	40.97	64.01	92.16	125.45	163.85	207.37	256.00	368.64	501.76
¾	16.00	21.77	28.45	44.45	64.00	87.12	113.78	144.00	177.77	256.00	348.44
⅞	11.75	16.00	20.90	32.66	47.02	64.01	83.60	105.80	130.61	188.09	256.00
1	9.00	12.25	16.0	25.0	36.00	49.01	64.00	81.00	100.00	144.00	196.00
1⅛	7.11	9.68	12.65	19.76	28.44	38.73	50.57	64.00	79.01	113.77	154.87
1¼	5.76	7.84	10.24	16.0	23.04	31.37	40.97	51.85	64.0	92.18	125.46
1⅜	4.76	6.48	8.46	13.23	19.04	25.92	33.85	42.84	52.89	76.16	103.66
1½	4.00	5.44	7.11	11.12	16.00	21.78	28.45	36.00	44.45	64.00	87.12
1⅝	3.41	4.64	6.06	9.47	13.63	18.56	24.24	30.68	37.87	54.53	74.22
1¾	2.94	4.0	5.23	8.17	11.75	16.00	20.90	26.45	32.66	47.03	64.00
1⅞	2.56	3.48	4.55	7.11	10.24	13.94	18.21	23.04	28.44	40.96	55.75
2	2.25	3.06	4.00	6.25	9.00	12.26	16.00	20.26	25.00	36.00	48.09
2¼	1.78	2.42	3.16	4.93	7.10	9.67	12.63	15.98	19.73	28.42	38.68
2½	1.44	1.96	2.56	4.0	5.76	7.84	10.24	12.96	16.0	23.04	31.35
2¾	1.19	1.62	2.12	3.31	4.76	6.48	8.46	10.72	13.22	19.04	25.92
3	1.00	1.36	1.78	2.78	4.0	5.43	7.11	9.00	11.11	16.0	21.77
3¼	.85	1.16	1.51	2.37	3.4	4.64	6.06	7.67	9.46	13.63	18.55
3½	.73	1.00	1.31	2.04	2.94	4.00	5.23	6.61	8.17	11.76	16.00
3¾	.64	.87	1.14	1.78	2.56	3.48	4.55	5.76	7.11	10.24	13.93
4	.56	.77	1.00	1.56	2.25	3.06	4.00	5.06	6.25	9.00	12.25
4¼	.50	.68	.89	1.38	1.99	2.71	3.54	4.49	5.53	7.97	10.85
4½	.44	.61	.79	1.23	1.78	2.42	3.16	4.00	4.94	7.11	9.68
4¾	.40	.54	.71	1.11	1.60	2.17	2.84	3.59	4.43	6.38	8.68
5	.36	.49	.64	1.00	1.44	1.96	2.56	3.24	4.00	5.76	7.84
5½	.30	.40	.53	1.00	1.19	1.62	2.12	2.68	3.30	4.76	6.48
6	.25	.34	.45	.83	1.00	1.36	1.78	2.25	2.78	4.00	5.45
6½	...	.29	.38	.69	.85	1.16	1.51	1.92	2.37	3.40	4.64
7	...	.25	.33	.59	.73	1.00	1.31	1.65	2.04	2.94	4.00
7½	...	...	.28	.51	.64	.87	1.14	1.44	1.78	2.56	3.48
8	...	...	.25	.44	.56	.77	1.00	1.27	1.56	2.25	3.06
8½	...	...	...	.39	.50	.68	.89	1.12	1.38	1.99	2.71
9	...	...	...	.35	.44	.60	.79	1.00	1.23	1.78	2.42
9½	...	...	...	.31	.40	.54	.71	.90	1.11	1.60	2.17
10	...	...	...	.28	.36	.49	.64	.81	1.00	1.44	1.96
10½	...	...	...	.25	.33	.44	.58	.73	.91	1.31	1.77
11	...	...	...	...	.30	.40	.53	.67	.83	1.19	1.62
12	...	...	...	...	.25	.34	.44	.56	.69	1.00	1.36
13	...	...	...	...	...	.29	.38	.48	.59	.85	1.16
14	...	...	...	...	...	.25	.33	.41	.51	.74	1.00
15	...	...	...	...	...	...	.28	.36	.44	.64	.87
16	...	...	...	...	...	...	.25	.32	.39	.56	.76
17	...	...	...	...	...	...	...	.28	.35	.50	.68
18	...	...	...	...	...	...	...	.25	.31	.45	.60

Table Giving Ratios of Areas — Continued

Diameter of Water Cylinders	DIAMETER OF STEAM CYLINDERS										
	16	18	20	22	24	26	28	30	32	34	36
⅝											
¾	455.09										
⅞	334.37										
1	256.0	324.00	400.00								
1⅛	202.27	256.00	316.05								
1¼	163.86	207.38	256.0	309.81							
1⅜	135.39	171.47	211.69	256.00							
1½	113.78	144.00	177.77	215.11	256.00						
1⅝	96.94	122.72	151.54	183.37	218.22						
1¾	83.60	105.79	130.61	158.05	188.10	220.71					
1⅞	72.82	92.16	113.78	137.67	163.85	192.29					
2	64.00	81.00	100.00	121.00	144.00	169.00	196.00	225.00	256.00		
2¼	50.56	64.00	79.01	95.60	113.78	131.56	154.87	177.77	202.27		
2½	40.96	51.84	64.00	77.44	92.16	108.16	125.44	144.00	163.84	184.97	
2¾	33.85	42.84	52.89	64.00	76.17	89.39	103.66	119.01	135.41	152.86	
3	28.44	36.00	44.44	53.77	64.00	75.11	87.11	100.00	113.77	128.44	144.00
3¼	24.23	30.67	37.87	45.83	54.54	64.00	74.24	85.22	96.96	109.46	122.72
3½	20.90	26.44	32.65	39.42	47.02	55.18	64.00	73.47	83.59	94.36	105.79
3¾	18.20	23.04	28.44	34.42	40.96	48.07	55.75	64.00	72.82	82.21	92.16
4	16.00	20.25	25.00	30.25	36.00	42.25	49.00	56.25	64.00	72.25	81.00
4¼	14.17	17.93	22.14	26.79	31.89	37.43	43.41	46.51	56.69	64.00	71.76
4½	12.64	16.00	19.75	23.90	28.44	33.33	38.71	44.44	50.56	57.08	64.00
4¾	11.34	14.36	17.73	21.45	25.53	29.96	34.75	39.89	45.38	51.24	57.44
5	10.24	12.96	16.00	19.20	23.04	27.04	31.36	36.00	40.96	46.24	51.84
5½	8.46	10.71	13.22	16.00	19.04	22.33	25.91	29.75	33.85	38.21	42.84
6	7.11	9.00	11.11	13.44	16.00	18.77	21.77	25.00	28.44	32.11	36.00
6½	6.06	7.66	9.46	11.45	13.63	16.00	18.56	21.30	24.23	27.36	30.67
7	5.22	6.61	8.16	9.87	11.75	13.79	16.00	18.37	20.90	23.59	26.44
7½	4.55	5.76	7.11	8.60	10.24	12.00	13.93	16.00	18.20	20.55	23.04
8	4.00	5.06	6.25	7.25	9.00	10.56	12.25	14.06	16.00	18.06	20.25
8½	3.54	4.48	5.53	6.69	7.97	9.35	10.85	12.45	14.17	16.00	17.92
9	3.15	4.00	4.93	5.85	7.11	8.34	9.67	11.11	12.64	14.27	16.00
9½	2.83	3.59	4.43	5.36	6.38	7.49	8.68	9.97	11.34	12.88	14.36
10	2.56	3.24	4.00	4.84	5.76	6.76	7.84	9.00	10.24	11.56	12.96
10½	2.32	2.94	3.63	4.39	5.22	6.13	7.10	8.16	9.29	10.48	11.75
11	2.11	2.67	3.30	4.00	4.76	5.58	6.47	7.43	8.46	9.55	10.71
12	1.77	2.25	2.77	3.36	4.00	4.67	5.44	6.25	7.11	8.02	9.00
13	1.51	1.91	2.37	2.86	3.40	4.00	4.63	5.32	6.06	6.83	7.66
14	1.30	1.65	2.04	2.46	2.93	3.44	4.00	4.59	5.22	5.89	6.61
15	1.13	1.44	1.77	2.13	2.56	3.00	3.48	4.00	4.55	5.13	5.76
16	1.00	1.26	1.56	1.89	2.25	2.64	3.06	3.51	4.00	4.51	5.06
17	.88	1.12	1.38	1.67	1.99	2.34	2.71	3.11	3.54	4.00	4.48
18	.79	1.00	1.23	1.49	1.77	2.08	2.41	2.77	3.15	3.56	4.00

Table of Capacity of Pumps

The figures at the extreme left of the table are piston or plunger diameters; the line of figures across the top are piston or plunger strokes; the figures in the body of the table are the capacity or displacement in gallons, corresponding to a single stroke. To find the capacity for one revolution, multiply the capacity for a single stroke by two.

Diam. of Cylinder Inches	LENGTH OF STROKE IN INCHES															
	2	3	4	5	6	7	12	13	16	18	20	24	25	33	36	38
1¼	.0106	.0159	.0212	.0266	.0319	.0372	.0638	.0691	.085	.0956	.1062	.1274	.1328	.1753	.1912	.2021
1⅜	.0129	.0193	.0257	.0321	.0386	.045	.0771	.0835	.1029	.1156	.1286	.1543	.1607	.2121	.2314	.2442
1½	.0153	.0229	.0306	.0382	.0459	.0535	.0918	.0994	.1224	.1377	.1530	.1836	.1912	.2524	.2754	.2907
1¾	.0208	.0312	.0416	.0521	.0625	.0729	.1249	.1353	.1666	.1874	.2082	.2499	.2603	.3436	.3748	.3956
2	.0272	.0408	.0544	.068	.0816	.0952	.1632	.1768	.2176	.2448	.2720	.3264	.340	.4489	.4897	.5169
2¼	.0344	.0516	.0688	.086	.1033	.1205	.2065	.2238	.2754	.3098	.3442	.4131	.4303	.568	.6196	.6541
2½	.0425	.0638	.0850	.1063	.1275	.1488	.255	.2763	.340	.3825	.425	.51	.5313	.7013	.765	.8075
2¾	.0514	.0771	.1029	.1286	.1543	.18	.3086	.3343	.4114	.4628	.5143	.6171	.6429	.8486	.9257	.9771
3	.0612	.0918	.1224	.1530	.1836	.2142	.3672	.3978	.4896	.5508	.612	.7344	.765	1.01	1.102	1.163
3¼	.0718	.1077	.1437	1796	.2154	.2514	.431	.4668	.5746	.6464	.7183	.8619	.8978	1.185	1.293	1.365
3½	.0833	.1249	.1666	2082	.2499	.2915	.4997	.5414	.6663	.7496	.833	.9995	1.041	1.374	1.499	1.583
3¾	.0957	.1435	.1913	.2392	.287	.3348	.574	.6214	.7653	.8610	.9561	1.148	1.196	1.579	1.722	1.818
4	.1088	.1632	.2176	.272	.3265	.3809	.653	.7074	.8706	.9795	1.088	1.306	1.36	1.796	1.959	2.068
4¼	.1229	.1843	.2457	3071	.3684	.4300	.7371	.7986	.9828	1.106	1.229	1.474	1.536	2.027	2.211	2.333
4½	.1377	.2065	.2753	.3443	.413	.4818	.826	.8948	1.101	1.239	1.377	1.652	1.721	2.271	2.478	2.616
4¾	.1534	.2301	.3068	.3835	.4603	.537	.9205	.9972	1.227	1.378	1.534	1.841	1.918	2.531	2.762	2.915
5	.17	.2550	.34	.4250	.51	.5950	1.02	1.105	1.36	1.53	1.7	2.04	2.125	2.805	3.060	3.23
5¼	.1874	.2812	.3749	.4686	.5623	.6561	1.125	1.218	1.5	1.687	1.874	2.249	2.343	3.093	3.374	3.561
5½	.2057	.3086	.4114	.5143	.6171	.72	1.234	1.337	1.646	1.851	2.057	2.468	2.571	3.394	3.703	3.908
5¾	.2248	.3373	.4497	.5621	.6745	.787	1.349	1.461	1.799	2.023	2.248	2.698	2.811	3.71	4.047	4.272
6	.2448	.3672	.4896	.612	.7343	.8567	1.469	1.59	1.958	2.203	2.448	2.938	3.06	4.038	4.406	4.65
6¼	.2656	.3981	.5312	.6641	.7969	.9297	1.594	1.727	2.125	2.39	2.656	3.188	3.32	4.383	4.781	5.047
6½	.2872	.4309	.5745	.7182	.8618	1.005	1.724	1.867	2.298	2.585	2.873	3.447	3.591	4.74	5.171	5.458
6¾	.3099	.4648	.6197	.7747	.9296	1.085	1.859	2.014	2.479	2.788	3.099	3.718	3.873	5.113	5.578	5.887
7	.3332	.4999	.6665	.8331	.9997	1.166	1.999	2.166	2.666	2.999	3.332	3.999	4.165	5.499	5.998	6.332
7¼	.4084	.6126	.8168	1.021	1.225	1.429	2.45	2.654	3.267	3.675	4.084	4.9	5.105	6.739	7.351	7.759
8	.4352	.6529	.8704	1 089	1.306	1.523	2.611	2.829	3.482	3.917	4.352	5.223	5.44	7.181	7.834	8.269
9	.5508	.8263	1.102	1.377	1.652	1.928	3.305	3.580	4.406	4.957	5.508	6.610	6.885	9.089	9.915	10.46
10	.68	1.02	1.36	1.7	2.04	2.38	4.08	4.42	5.44	6.12	6.8	8.16	8.5	11.22	12.24	12.92
10½	.7497	1.125	1.499	1.874	2.249	2.624	4.498	4.873	5.998	6.747	7.497	8.996	9.37	12.37	13.49	14.24
11	.8228	1.234	1.646	2.057	2.468	2.88	4.957	5.348	6.582	7.405	8.228	9.873	10.28	13.58	14.81	15.63
12	.9792	1.469	1.958	2.488	2.938	3.427	5.875	6.365	7.834	8.813	9.792	11.75	12.24	16.16	17.63	18.6
13	1.149	1.723	2.297	2.872	3.445	4.022	6.894	7.467	9.192	10.34	11.49	13.78	14.36	18.96	20.69	21.83
14	1.332	1.998	2.665	3.331	3.977	4.664	7.994	8.661	10.66	11.99	13.32	15.98	16.66	21.99	23.99	25.32
15	1.53	2.295	3.06	3.825	4.59	5.354	9.18	9.943	12.23	13.77	15.29	18.36	19.12	25.24	27.54	29.07
16	1.74	2.61	3.48	4.35	5.22	6.09	10.44	11.31	13.92	15.66	17.40	20.88	21.76	28.72	31.33	33.07

For the contents of a greater diameter than any in the table, take the quantity opposite *one-half* said diameter and multiply it by 4.

Diameter in Inches	Diameter in Decimals of a Foot	For 1 Foot in Length: Cubic Ft. Also Area in Sq. Ft.	For 1 Foot in Length: Gallons of 231 Cubic Inches	Diameter in Inches	Diameter in Decimals of a Foot	For 1 Foot in Length: Cubic Ft. Also Area in Sq. Ft.	For 1 Foot in Length: Gallons of 231 Cubic Inches	Diameter in Inches	Diameter in Decimals of a Foot	For 1 Foot in Length: Cubic Ft. Also Area in Sq. Ft.	For 1 Foot in Length: Gallons of 231 Cubic Inches
1/4	.0208	.0003	.0025	3/4	.5625	.2485	1.859	19	1.583	1.969	14.73
5/16	.0260	.0005	.0040	7	.5833	.2673	1.999	1/2	1.625	2.074	15.51
3/8	.0313	.0008	.0057	1/4	.6042	.2867	2.145	20	1.667	2.182	16.32
7/16	.0365	.0010	.0078	1/2	.6250	.3068	2.295	1/2	1.708	2.292	17.15
1/2	.0417	.0014	.0102	3/4	.6458	.3276	2.450	21	1.750	2.405	17.99
9/16	.0469	.0017	.0129	8	.6667	.3491	2.611	1/2	1.792	2.521	18.86
5/8	.0521	.0021	.0159	1/4	.6875	.3712	2.777	22	1.833	2.640	19.75
11/16	.0573	.0026	.0193	1/2	.7083	.3941	2.948	1/2	1.875	2.761	20.66
3/4	.0625	.0031	.0230	3/4	.7292	.4176	3.125	23	1.917	2.885	21.58
13/16	.0677	.0036	.0269	9	.7500	.4418	3.305	1/2	1.958	3.012	22.53
7/8	.0729	.0042	.0312	1/4	.7708	.4667	3.491	24	2.000	3.142	23.50
15/16	.0781	.0048	.0359	1/2	.7917	.4922	3.682	25	2.083	3.409	25.50
1	.0833	.0055	.0408	3/4	.8125	.5185	3.879	26	2.167	3.687	27.58
1/4	.1042	.0085	.0638	10	.8333	.5454	4.080	27	2.250	3.976	29.74
1/2	.1250	.0123	.0918	1/4	.8542	.5730	4.286	28	2.333	4.276	31.99
3/4	.1458	.0167	.1249	1/2	.8750	.6013	4.498	29	2.417	4.587	34.31
2	.1667	.0218	.1632	3/4	.8958	.6303	4.715	30	2.500	4.909	36.72
1/4	.1875	.0276	.2066	11	.9167	.6600	4.937	31	2.583	5.241	39.21
1/2	.2083	.0341	.2550	1/4	.9375	.6903	5.164	32	2.667	5.585	41.78
3/4	.2292	.0412	.3085	1/2	.9583	.7213	5.396	33	2.750	5.940	44.43
3	.2500	.0491	.3672	3/4	.9792	.7530	5.633	34	2.833	6.305	47.16
1/4	.2708	.0576	.4310	12	1.000	.7854	5.875	35	2.917	6.681	49.98
1/2	.2917	.0668	.4998	1/2	1.042	.8522	6.375	36	3.000	7.069	52.88
3/4	.3125	.0767	.5738	13	1.083	.9218	6.895	37	3.083	7.467	55.86
4	.3333	.0873	.6528	1/2	1.125	.9940	7.436	38	3.167	7.876	58.92
1/4	.3542	.0985	.7369	14	1.167	1.069	7.997	39	3.250	8.296	62.06
1/2	.3750	.1104	.8263	1/2	1.208	1.147	8.578	40	3.333	8.727	65.28
3/4	.3958	.1231	.9206	15	1.250	1.227	9.180	41	3.417	9.168	68.58
5	.4167	.1364	1.020	1/2	1.292	1.310	9.801	42	3.500	9.621	71.97
1/4	.4375	.1503	1.125	16	1.333	1.396	10.44	43	3.583	10.085	75.44
1/2	.4583	.1650	1.234	1/2	1.375	1.485	11.11	44	3.667	10.559	78.99
3/4	.4792	.1803	1.349	17	1.417	1.576	11.79	45	3.750	11.045	82.62
6	.5000	.1963	1.469	1/2	1.458	1.670	12.49	46	3.833	11.541	86.33
1/4	.5208	.2131	1.594	18	1.500	1.767	13.22	47	3.917	12.048	90.13
1/2	.5417	.2304	1.724	1/2	1.542	1.867	13.96	48	4.000	12.566	94.00

Heights in Feet to Which Pumps Will Elevate Water

Steam pressure, 50 pounds per square inch at the pump. No allowance made for friction in pipes, etc.

Diameter of Steam Cylinders	DIAMETER OF WATER CYLINDERS																
	2 Inch	2½ Inch	3 Inch	3½ Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	10½ Inch	12 Inch	14 Inch	16 Inch	18 Inch	20 Inch
3½	230	147	102	75	58	37											
4	300	192	134	134	75	48	34										
5	469	300	209	153	117	75	52	38									
6	675	432	300	221	169	108	75	55	42	33							
7	920	588	408	300	230	147	102	75	57	45	37						
8	...	768	533	344	300	192	141	98	75	59	48	44					
9	...	972	675	496	380	243	169	124	95	75	61	55	42				
10	...	...	833	612	469	300	208	153	117	94	75	68	50	38			
12	...	...	...	881	675	432	300	220	169	133	108	97	75	55	42		
14	...	...	...	...	920	588	408	300	228	182	147	133	102	75	57	45	
16	...	...	...	...	...	768	564	392	300	236	192	174	141	98	75	59	48
18	...	...	...	...	...	972	650	490	379	300	243	220	162	122	95	75	61
20	...	...	...	...	...	...	833	600	469	370	300	272	208	150	117	92	75
22	...	...	...	...	...	...	1008	741	567	448	364	329	252	185	142	112	91
24	...	...	...	...	...	...	...	882	675	533	432	392	300	220	169	133	108
26	...	...	...	...	...	...	...	1034	788	626	508	460	356	258	197	156	127
28	...	...	...	...	...	...	...	...	919	726	588	533	407	300	230	181	147
30	...	...	...	...	...	...	...	...	1054	834	676	612	468	345	263	208	169
32	...	...	...	...	...	...	...	...	...	948	798	697	533	391	300	237	192
34	...	...	...	...	...	...	...	...	...	1070	868	786	603	442	339	268	217
36	...	...	...	...	...	...	...	...	...	...	972	881	675	495	380	300	243

The maximum limit of piston speed depends upon the head pumped against.

Wrought Iron Pipe for Steam, Gas or Water

TABLE OF STANDARD DIMENSIONS

Nominal Inside Diameter	Actual Inside Diameter Inches	Actual Outside Diameter Inches	Internal Circumference Inches	External Circumference Inches	Length of Pipe per Square Foot of Inside Surface Feet	Length of Pipe per Square Foot of Outside Surface Feet	Internal Area Inches	External Area Inches	Length of Pipe Containing 1 Cubic Foot Feet	Nominal Weight per Foot Pounds	Number of Threads per Inch of Screw	Contents in Gallons per Foot
⅛	0.270	0.405	0.848	1.272	14.15	9.44	0.0572	0.129	2500.0	0.243	27	.0006
¼	0.364	0.54	1.144	1.696	10.50	7.075	0.1041	0.229	1385.0	0.422	18	.0026
⅜	0.494	0.675	1.552	2.121	7.67	5.657	0.1916	0.358	751.5	0.561	18	.0057
½	0.623	0.84	1.957	2.652	6.13	4.502	0.3048	0.554	472.4	0.845	14	.0102
¾	0.824	1.05	2.589	3.299	4.635	3.637	0.5333	0.866	270.0	1.126	14	.0230
1	1.048	1.315	3.292	4.134	3.679	2.903	0.8627	1.357	166.9	1.67	11½	.0408
1¼	1.380	1.66	4.335	5.215	2.768	2.301	1.496	2.164	96.25	2.258	11½	.0638
1½	1.611	1.9	5.061	5.969	2.371	2.01	2.038	2.835	70.65	2.694	11½	.0918
2	2.067	2.375	6.494	7.461	1.848	1.611	3.355	4.430	42.36	3.667	11½	.1632
2½	2.468	2.875	7.754	9.032	1.547	1.328	4.783	6.491	30.11	5.773	8	.2550
3	3.067	3.5	9.636	10.996	1.245	1.091	7.388	9.621	19.49	7.547	8	.3673
3½	3.518	4.0	11.146	12.566	1.077	0.955	9.887	12.566	14.56	9.055	8	.4998
4	4.026	4.5	12.648	14.137	0.949	0.849	12.730	15.904	11.31	10.728	8	.6528
4½	4.508	5.0	14.153	15.708	0.848	0.765	15.939	19.635	9.03	12.34	8	.8263
5	5.045	5.563	15.849	17.475	0.757	0.629	19.990	24.299	7.20	14.564	8	1.020
6	6.065	6.625	19.054	20.813	0.63	0.577	28.889	34.471	4.98	18.767	8	1.469
7	7.023	7.625	22.063	23.954	0.544	0.505	38.737	45.663	3.72	23.41	8	1.999
8	7.982	8.625	25.076	27.096	0.478	0.444	50.039	58.426	2.88	28.348	8	2.611
9	9.001	9.688	28.277	30.433	0.425	0.394	63.633	73.715	2.26	34.077	8	3.300
10	10.019	10.75	31.475	33.772	0.381	0.355	78.838	90.762	1.80	40.641	8	4.081
11	11.0	11.75	34.55	36.91	0.34	0.32	95.03	108.43	1.50	45.0	8	4.93
12	12.0	12.75	37.70	40.05	0.32	0.30	113.0	127.67	1.27	48.98	8	5.87

Friction Loss in Pounds Pressure per Square Inch

For each 100 feet of length in different size clean iron pipes discharging given quantities of water per minute.

Gallons Discharged per Minute	½ Inch	¾ Inch	1 Inch	1¼ Inch	1½ Inch	2 Inch	2½ Inch	3 Inch	3½ Inch	4 Inch	5 Inch	6 Inch	Gallons Discharged per Minute
	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	
5	24.6	3.3	.84	.31	.12	.....	.....	.....	.....	....	....	....	5
10	96.0	13.0	3.16	1.05	.47	.12	.....	.....	.....	....	....	....	10
15	....	28.7	6.98	2.38	.97	.....	.....	.....	.....	....	....	....	15
20	....	50.4	12.3	4.07	1.66	.42	.....	.....	.....	....	....	....	20
25	....	78.0	19.0	6.40	2.62	.....	.21	.10	.....	....	....	....	25
30	....	....	27.5	9.15	3.75	.91	.....	.....	.....	....	....	....	30
35	....	....	37.0	12.04	5.05	.....	.....	.....	.....	....	....	....	35
40	....	....	48.0	16.1	6.52	1.60	.....	.....	.....	....	....	....	40
45	....	....	.....	20.2	8.15	.....	.....	.....	.....	....	....	....	45
50	....	....	.....	24.9	10.0	2.44	.81	.35	.16	.09	.03	....	50
75	....	....	.....	56.1	22.4	5.32	1.80	.74	.34	....	....	....	75
100	....	....	.....	.....	39.0	9.46	3.20	1.31	.60	.33	.12	.05	100
125	....	....	.....	.....	.....	14.9	4.89	1.99	.90	....	....	....	125
150	....	....	.....	.....	.....	21.2	7.0	2.85	1.32	.69	.25	.10	150
175	....	....	.....	.....	.....	28.1	9.46	3.85	1.78	....	....	....	175
200	....	....	.....	.....	.....	37.5	12.48	5.02	2.32	1.22	.42	.17	200
250	....	....	.....	.....	.....	.....	19.66	7.76	3.55	1.89	.65	.46	250
300	....	....	.....	.....	.....	.....	28.06	11.2	5.23	2.66	.93	.37	300
350	....	....	.....	.....	.....	.....	.....	15.2	7.0	3.65	1.28	.50	350
400	....	....	.....	.....	.....	.....	.....	19.5	9.0	4.73	1.68	.65	400
450	....	....	.....	.....	.....	.....	.....	25.0	11.60	6.01	2.10	.81	450

Friction Loss in Pounds Pressure per Square Inch

For each 100 feet of length in different size clean iron pipes discharging given quantities of water per minute.

Gallons Discharged per Minute	5 Inch	6 Inch	8 Inch	10 Inch	12 Inch	14 Inch	16 Inch	18 Inch	20 Inch	24 Inch	30 Inch	Gallons Discharged per Minute
	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	
250	.65	.26	.07	.03	.01	....	....	....	....	....	....	250
500	2.70	.96	.25	.09	.04	.017	.009	.005	....	....	....	500
750	5.40	2.21	.53	.18	.08	....	....	....	....	....	....	750
1,000	9.60	3.88	.94	.32	.13	.062	.036	.020	.012	.005	.002	1,000
1,250	....	....	1.46	.49	.20	....	....	....	....	....	....	1,250
1,500	....	....	2.09	.70	.29	.135	.071	.040	....	....	....	1,500
1,750	....	....	....	.95	.38	....	....	....	....	....	....	1,750
2,000	....	....	....	1.23	.49	.234	.123	.071	.042	.020	.006	2,000
2,250	....	....	....	....	.63	....	....	....	....	....	....	2,250
2,500	....	....	....	....	.77	.362	.188	.107	....	....	....	2,500
3,000	....	....	....	....	1.11	.515	.267	.150	.091	.047	.012	3,000
3,500	....	....	....	....	....	.697	.365	.204	....	....	....	3,500
4,000	....	....	....	....	....	.910	.472	.263	.158	.067	.022	4,000
4,500	....	....	....	....	....	....	.593	.333	....	....	....	4,500
5,000	....	....	....	....	....	....	.730	.408	.244	.102	.035	5,000
6,000	....	....	....	....	....	....	....	.585	.348	.146	.048	6,000
7,000	....	....	....	....	....	....	....	....	.472	.196	.065	7,000
8,000	....	....	....	....	....	....	....	....	.612	.255	.083	8,000
9,000	....	....	....	....	....	....	....	....	....	.323	.105	9,000
10,000	....	....	....	....	....	....	....	....	....	.396	.131	10,000

Pounds Pressure Lost by Friction

In each 100 feet of 2½-inch fire hose, for given discharges of water per minute.

Diameter of Nozzle, Inches	PRESSURE AT HOSE NOZZLE								
	Head in pounds per sq. in.	20	30	40	50	60	70	80	90	100
	Head in feet	46.2	69.3	92.4	115.5	138.6	161.7	184.8	207.9	231.0
1	Gallons discharged	110	134	155	173	189	205	219	232	245
	Rubber hose, pounds	4.35	6.40	8.40	10.20	12.80	14.80	17.0	19.20	20.50
	Leather hose, pounds	6.33	8.53	10.83	13.10	15.34	17.79	20.11	22.40	24.83
1⅛	Gallons discharged	139	170	196	219	240	259	277	294	310
	Rubber hose, pounds	6.79	10.16	13.60	17.05	20.59	24.0	27.0	30.0	33.0
	Leather hose, pounds	9.05	12.71	16.38	20.11	23.88	27.61	31.41	35.24	39.07
1¼	Gallons discharged	171	210	242	271	297	320	342	363	383
	Rubber hose, pounds	10.28	15.64	20.85	25.46	29.50	39.0	43.81	49.42	55.0
	Leather hose, pounds	12.84	19.0	24.07	30.11	35.94	41.57	47.36	53.25	59.20
1⅜	Gallons discharged	207	253	293	327	358	387	413	439	462
	Rubber hose, pounds	15.0	22.96	29.40	40.50	48.20	55.70	64.70	72.0	79.26
	Leather hose, pounds	18.81	26.39	35.01	43.38	52.0	60.40	68.59	76.73	84.87

Horizontal and Vertical Distances Reached by Jets

Diameter of Nozzle, Inches	PRESSURE AT NOZZLE								
	Head in pounds per sq. in.	20	30	40	50	60	70	80	90	100
	Head in feet	46.2	69.3	92.4	115.5	138.6	161.7	184.8	207.9	231.0
1	Gallons discharged	110	134	155	173	189	205	219	232	245
	Horizontal distance of jet	70	90	109	126	142	156	168	178	186
	Vertical distance of jet	43	62	79	94	108	121	131	140	148
1⅛	Gallons discharged	131	170	196	219	240	259	277	294	310
	Horizontal distance of jet	71	93	113	132	148	163	175	186	193
	Vertical distance of jet	43	63	81	97	112	125	137	148	157
1¼	Gallons discharged	171	210	242	271	297	320	342	363	383
	Horizontal distance of jet	73	96	118	138	156	172	186	198	207
	Vertical distance of jet	43	63	82	99	115	129	142	154	164
1⅜	Gallons discharged	207	253	293	327	358	387	413	439	462
	Horizontal distance of jet	75	100	124	146	166	184	200	213	224
	Vertical distance of jet	44	65	85	102	118	133	146	158	169

French or Metric Measures

The metric unit of length is the meter=39.37 inches.
The metric unit of weight is the gram=15.432 grains.
The following prefixes are used for sub-divisions and multiples: Milli $=\frac{1}{1000}$, Centi $=\frac{1}{100}$, Deci $=\frac{1}{10}$, Deca = 10, Hecto = 100, Kilo = 1,000, Myria = 10,000.

French and British (and American) Equivalent Measures

Measures of Length

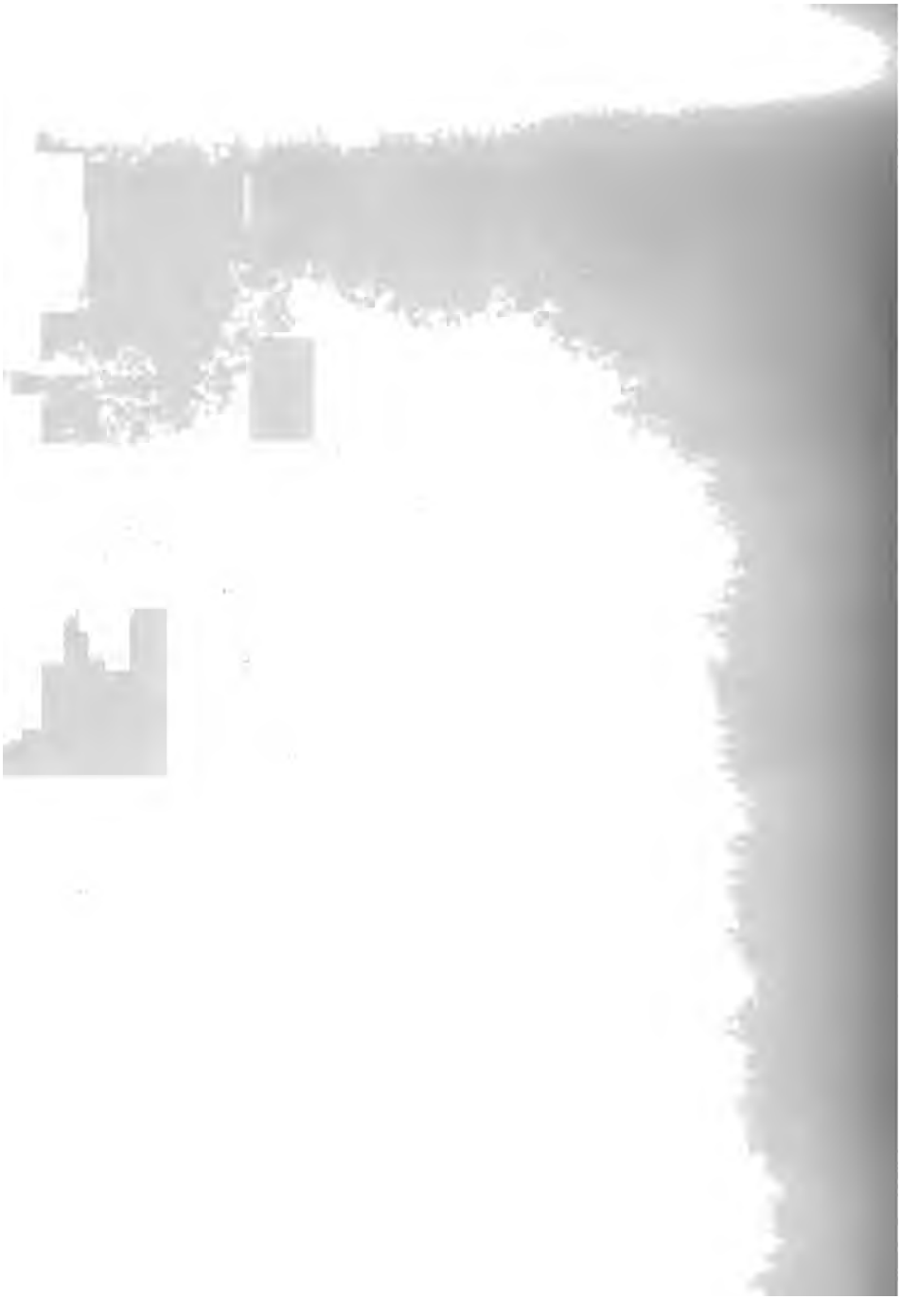
French	British and U. S.
1 meter	=39.37 inches, or 3.28083 feet, 1.09361 yards.
.3048 meter	=1 foot.
1 centimeter	=.3937 inch.
2.54 centimeters	=1 inch.
1 millimeter	=.03937 inch, or $\frac{1}{25}$ inch nearly.
25.4 millimeters	=1 inch.
1 kilometer	=1093.61 yards, or .62137 mile.

Measures of Capacity

1 liter (=1 cubic decimeter)	=	61.023 cubic inches. .03531 cubic foot. .2642 gallon (American). 2.202 pounds of water at 62° F.
28.317 liters	=	1 cubic foot.
4.543 liters	=	1 gallon (British).
3.785 liters	=	1 gallon (American).

Measures of Weight

French		British and U. S.
1 gram	=	15.432 grains.
.0648 gram	=	1 grain.
28.35 gram	=	1 ounce avoirdupois.
1 kilogram	=	2.2046 pounds.
.4536 kilogram	=	1 pound.
1 tonne or metric ton 1000 kilograms	=	.9842 ton of 2240 pounds. 19.68 cwts. 2204.6 pounds.
1.016 metric tons 1016 kilograms	=	1 ton of 2240 pounds.



The Story of the Cameron

THE CAMERON Clan made its first appearance on the pages of history in the year 1411 when the clan bearing this name was formed by one Donald Du, a character embodying to a high degree the Scotch characteristics of strength, patriotism and kindred qualities.

These virtues impressed themselves upon the clan as a whole, and have been handed down from generation to generation; so that, to this day, the name *CAMERON*

Consultation of Engineers and Shop Executives in the Cameron Factory

stands for a certain rugged integrity, well symbolized by the oak, which was the badge of the clan and the acorn, which is the Trade Mark of Cameron Pumps.

One of the descendants of the original clan was Adam Scott Cameron, who was born in the early part of the 19th century. In addition to the traditional good qualities which he inherited, he had a certain mechanical and inventive ability that ultimately found expression in the line of steam pumps bearing his name—a line which for many years formed the entire product of this company.

Physical Laboratory where delicate experiments provide Standards for Cameron Manufacture

Some years ago, shortly after the advent of the modern high efficiency centrifugal pump, the Company undertook the development of a line of centrifugal pumping machinery, and in establishing this line naturally felt a peculiar responsibility in view of the splendid traditions involved.

With the view to showing the manner in which these responsibilities are being carried out, this *Story of the Cameron* has been prepared, and is presented for your thoughtful consideration.

Some Drivers for Cameron:–
Gasoline Motor
—
Electric Motor
—
Steam Turbine

The extreme care exhibited in forming Cameron patterns and the use of modern moulding machinery give a good foundation for "Cameron Quality Pumps."

The illustrations show

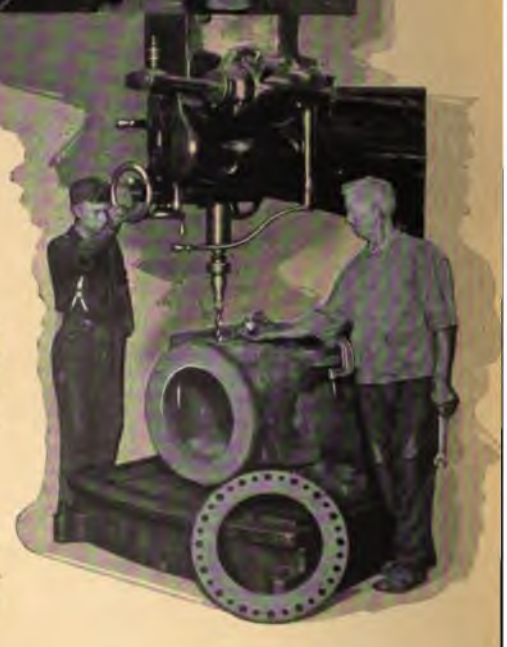
Checking measurements of Cameron pattern.

Removing pattern from drag.

Building a dry sand core for impeller.

When the mixture is just right as to constituents and temperature it is poured into the flasks. The temperature of the molten metal is tested with an optical pyrometer and is made to conform with predetermined standards established in our own laboratories.

The illustrations show
Pouring, in the iron foundry.
Temperature test with the optical pyrometer.
Chipping bronze impeller casting.



In the Cameron daylight shops, machining is a precise art, not merely a phase of production.

The illustrations show

Planing lower half of pump casing.

Drilling pump casing. Note special jig.

The use of special tools permits extremely close limits, insuring a perfect fit. Every dollar of manufacturing cost is devoted to necessary work—done right the first time.

The illustrations show

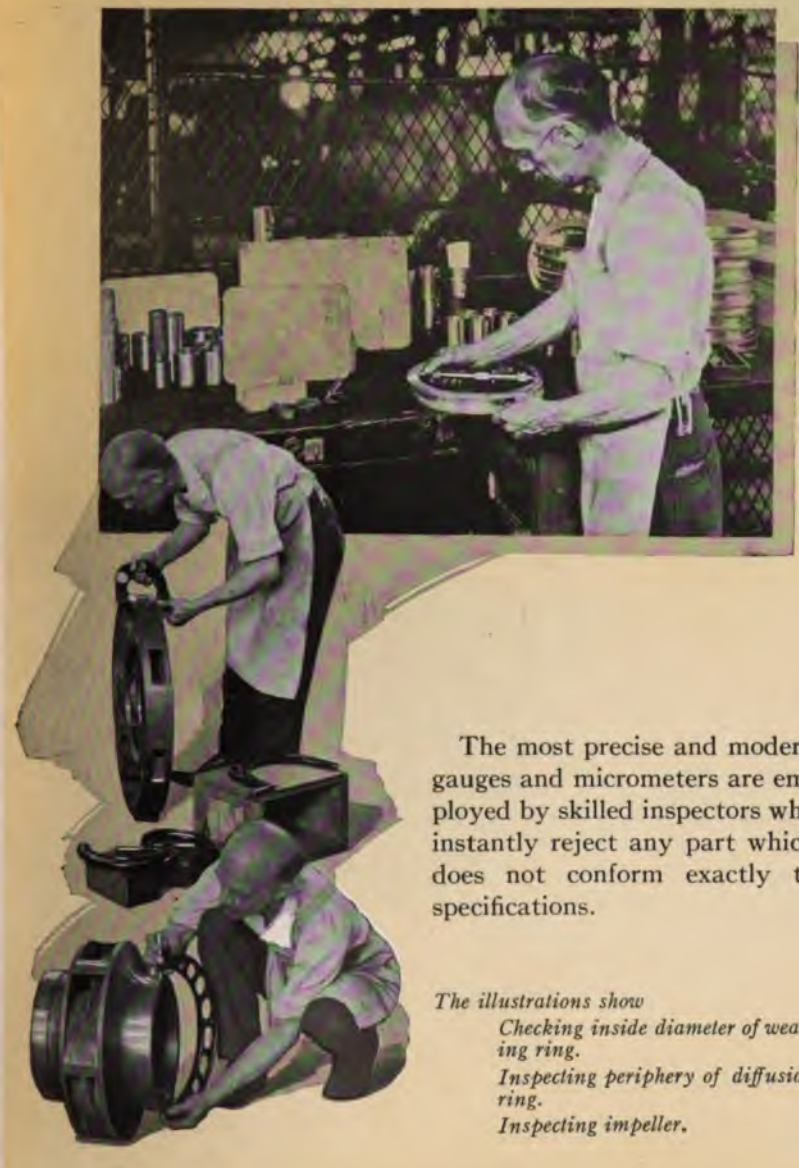
Boring interior of turbine pump casing.

Grinding impeller shaft.

Boring the bearings. Note use of special tool to insure concentricity.

In their progress through the shop, impellers are formed to meet the particular requirements of each customer.

The illustrations show
Turning an impeller.
Finishing touches with file.
Balancing an impeller.



The most precise and modern gauges and micrometers are employed by skilled inspectors who instantly reject any part which does not conform exactly to specifications.

The illustrations show

Checking inside diameter of wearing ring.

Inspecting periphery of diffusion ring.

Inspecting impeller.

We now pass to the assembly department. Great skill is necessary to the proper assembly of a pump, and Cameron assemblers have been trained by years in the service of the company.

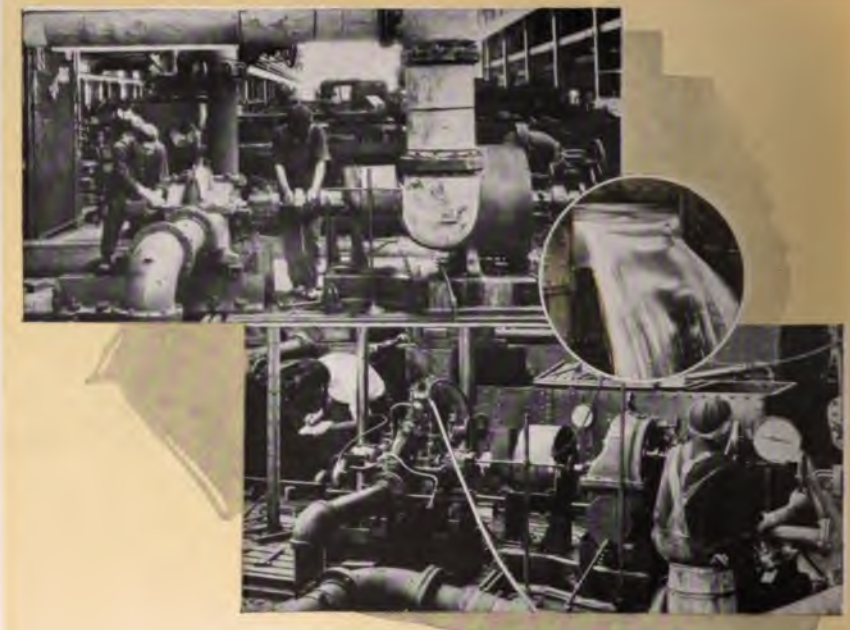
The illustrations show

Lower half of pump casing being lowered to assembly bench.

Placing the assembled rotor in the pump.

The illustrations show
Adjusting bearing bushings.
Placing upper half of casing on pump.

In the assembly of Cameron Pumps, workmen must not only be familiar with the proper location of integral parts but also with the operation of the pump as a whole. This is still another check upon the inspection department and further safeguards the customer's interests.



The "Proof of the Cameron" is in the testing. All Cameron Pumps are subjected to a full load test duplicating service conditions. Torsion dynamometers and other carefully calibrated instruments of precision are exclusively used to obtain perfect accuracy in testing.

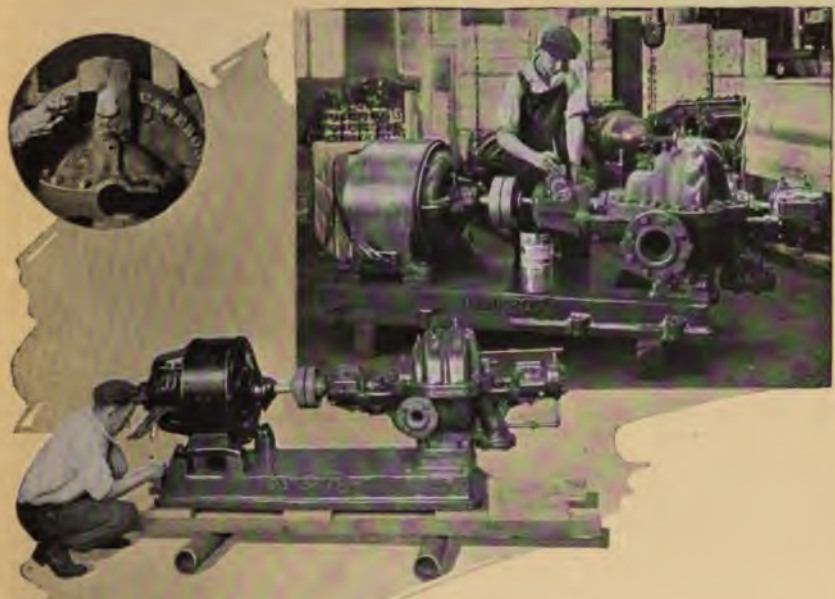
The illustrations show
Erecting pump on test block.
Weir for measuring capacities.
Testing Pump. Note dynamometer and mercury columns.

Every Cameron pump casing receives an extremely severe hydrostatic test for resistance to pressures. So exhaustive and thorough is Cameron testing routine that a factory test chart exhibits the entire range of a pumps actions and possibilities.

The illustrations show
Hydrostatic test of centrifugal pump.
Preparing the casing for the test.

After the pump has passed the chief tester and final inspection, it is carefully aligned with the driver in perfect operating condition.

The illustrations show
Placing Cameron Pump on bed plate with driver.
Aligning pump with driver.



Five separate processes are considered necessary to complete the painting of a Cameron Pump from the viewpoint of preservation and appearance. Every pump when it has received its finishing coat presents a smooth, attractive appearance which will last throughout the years.

The illustrations show

Applying finishing coat of steel grey.

The Acorn—trade mark of "Cameron Quality."

Mounting the pump on skids.

Knowledge of transportation problems related to packing and shipping and the exercise of such knowledge in the shipment of Cameron Pumps, are part of Cameron Service to customers.

The illustrations show

Pump and driver being crated for domestic shipment. Note thickness of lumber in skid.

Pump being boxed for export. Note bracing of box.

Pump completely packed for export. Note extensions on ends of case to take up rope strain when lightering.

With the shipment of the pump the manufacturing story of the Cameron is concluded. There is still another story, however, that of "Cameron Service," which begins where the other leaves off and is, in itself, never ending. Cameron Service begins with the delivery of a Cameron Pump to the purchaser and continues on and on, each chapter expressive of satisfaction on the part of the user and giving perhaps the best possible recommendation for Cameron Pumps to those not already familiar with their merits.

Cameron Centrifugal Pumps in Service

Cameron Direct Acting Simplex Pumps in Service

A. S. CAMERON STEAM PUMP WORKS

Administrative Offices

11 Broadway, New York, N. Y., U. S. A.

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Butte, Mont.—303 Lewisohn Bldg. (Ingersoll-Rand Co.)
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Cleveland, Ohio.—Williamson Bldg.
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11 BROADWAY

NEW YORK

A. S. CAMERON STEAM PUMP WORKS

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Cameron Centrifugal Pumps

A. S. CAMERON STEAM PUMP WORKS
11 Broadway, New York

Bulletin No. 150 May, 1913

CAMERON DOUBLE SUCTION VOLUTE
CENTRIFUGAL PUMP

Cameron Centrifugal Pumps

THE SLOGAN OF THE CAMERON—

"CHARACTER: THE GRANDEST THING."

INTRODUCTION

THERE is a general tendency towards the use of rotative high speed machinery in almost all classes of prime movers. This is especially true of hydraulic machinery, electric motors, and steam turbines, which have been developed to a point that permits of their use for general purposes on a basis of economy and safe operation.

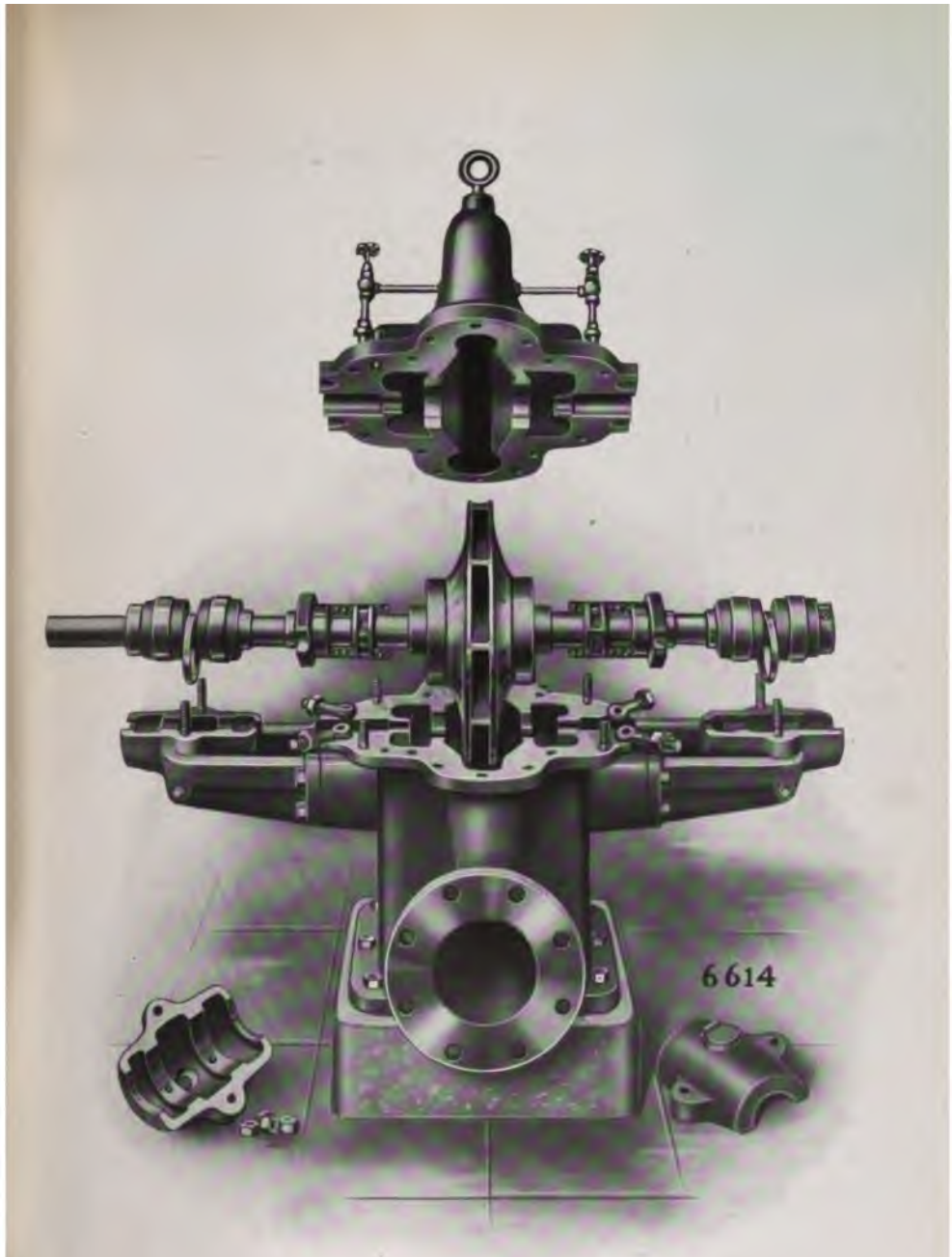
As a result of this, the high speed centrifugal pump has won distinction and favor among pump users, because of its simple construction, and the entire absence of complicated mechanism, valves, pistons, etc., as well as its low price and maintenance cost. It discharges a continuous steady stream without noise or shock, which permits pumping under the most ideal conditions. It requires small floor space, and only a light foundation.

The growing necessity for these pumps and the demand of users that they be made more accessible for cleaning and repairing, has been successfully met by our horizontally split design, which permits inspection of all internal parts without disturbing the pipe connections or alignment of the pump, while the double suction principle eliminates the use of marine thrust bearings, and permits high speeds with a comparatively simple construction, high efficiency and low cost of maintenance.

All of these important features are embodied in the Cameron Double Suction Volute Pump. Its design is new and wholly up-to-date. The volute chamber and impeller are designed and proportioned to correspond with the hydraulic conditions for which the pump is to be used. This insures maximum efficiency through a wide range of pumping at constant and variable speeds.

We carry in stock a line of types and sizes most in demand.

Place us on your list and send us your specifications whenever you are in the market or contemplate installing Centrifugal Pumps.



DOUBLE SUCTION VOLUTE PUMP, CASING OPEN

Cameron Centrifugal Pumps

SERVICE: The Cameron Double Suction Volute Pump can be used for heads up to 200 feet, higher heads depending upon capacity and speed available. It may be driven by motor, turbine, gas engine or belt to suit conditions.

It is adapted for pumping liquids and semi-liquids, including pulp, tar, oil and syrup, and for water works, reclamation, sewage, excavating, caissons, wrecking, mines, pulp and paper mills, ships and dry docks. You are invited to correspond with us if your conditions are special.

GENERAL DESIGN: This pump is of the horizontal type, and is fitted with a double suction impeller, which is perfectly balanced and free from all end thrust, common to the single suction design.

The pump casing is split on its horizontal centre line, which gives easy access to all interior parts for inspection or cleaning, without disturbing alignment of the pump, or pipe connections.

CASING: The pump casing is made of close grained cast iron, horizontally split and cast integral with side heads and stuffing boxes, eliminating thereby all possibility of leakage. The water passages have the proper area to suit the pumping conditions.

IMPELLER: The impeller is of the enclosed type and designed to reduce the losses due to shock and friction to a minimum, i.e., the entrance and exit angles of the impeller vanes and its curvatures are scientifically developed to accomplish that result.

All outside surfaces are machine finished. The inside channels and vane surfaces are carefully cleaned or scraped to diminish undue friction. The impeller is secured to the shaft by means of a properly fitted key.

BUSHING RING: Renewable bushing rings of hard bronze are placed at both sides of casing around suction inlet of impeller to take up all wear. They are carefully fitted, and all clearance reduced to a minimum to avoid undue losses from leakage (back flow).

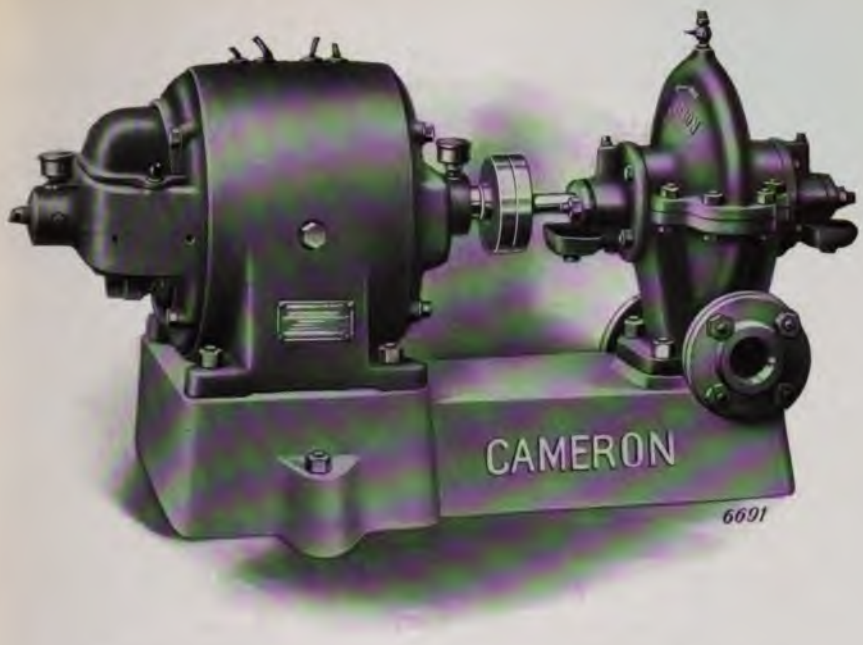
PUMP SHAFT: The pump shaft is made of high carbon steel accurately finished and ground, and of ample strength to transmit the power without undue vibration.

SHAFT SLEEVES: Both ends of the shaft are provided with renewable bronze sleeves to protect the shaft from corrosion, and to take up all wear in the stuffing boxes. The sleeves are screwed on to the shaft and hold the impeller in a central position.

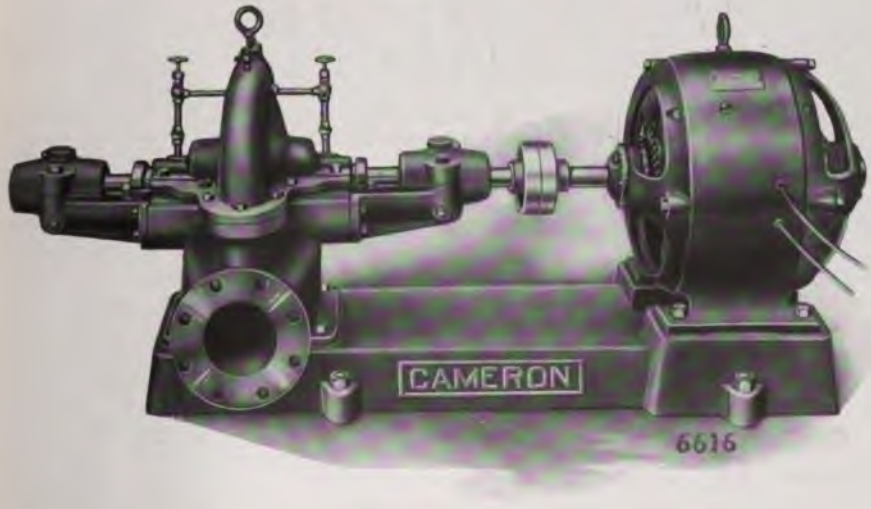
STUFFING BOXES: The stuffing boxes are deep, and are water sealed to prevent any possibility of air entering the pump. To admit of quick access for renewing packing rings, the gland adjusting bolts are of the swing bolt type.

BEARINGS: The bearings are of the ring oil type, horizontally split. The shaft runs in split bushings lined with the best anti-friction metal.

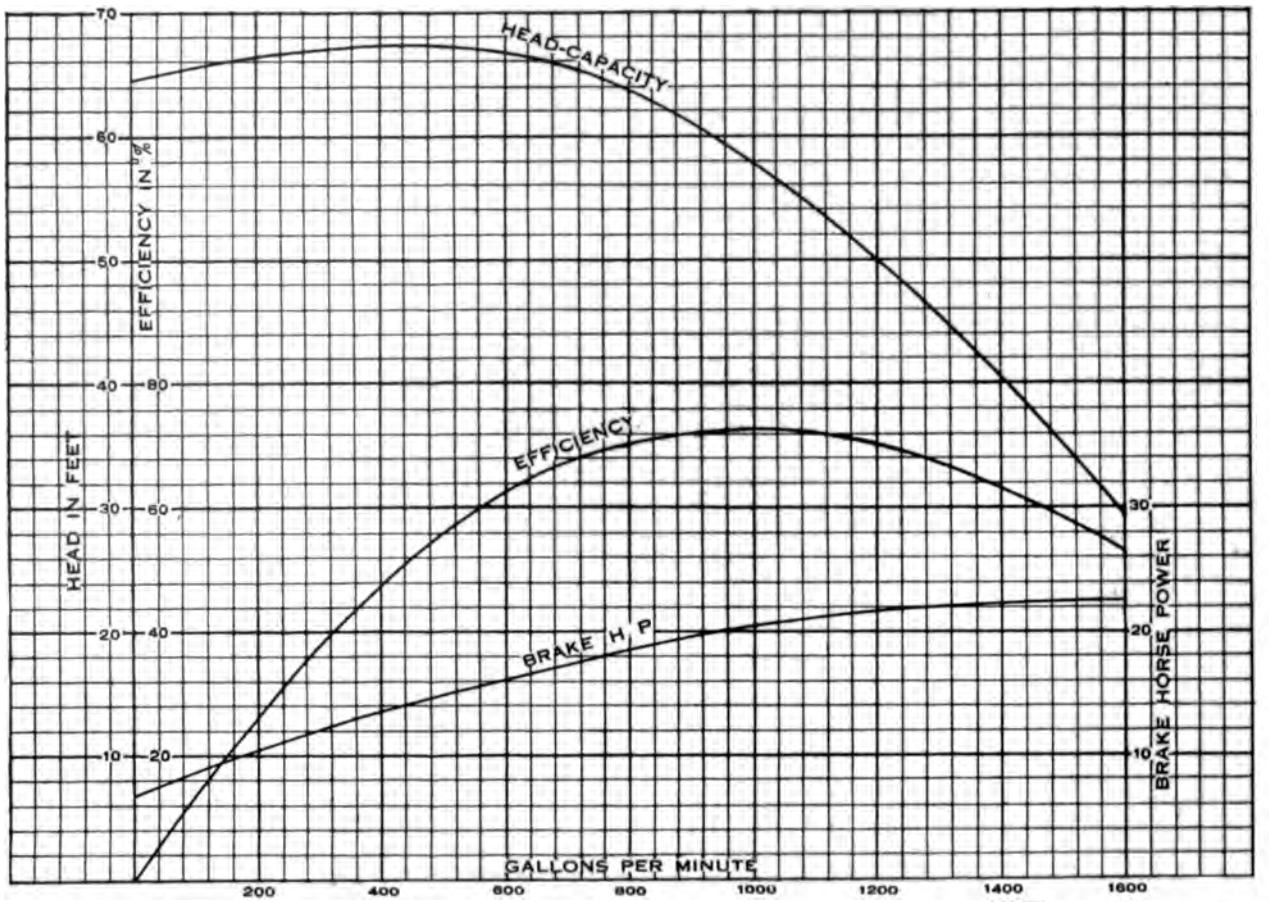
THRUST BEARINGS: In this type of pump the impeller is in perfect axial balance and does not require a special thrust bearing. In order to keep the impeller in its proper place and insure its central position with the vertical centre-line of the pump casing there are cast iron collars at either side of bearing, secured to the shaft by means of countersunk set screws.



2″ DOUBLE SUCTION VOLUTE PUMP, MOTOR DRIVEN



5″ DOUBLE SUCTION VOLUTE PUMP, MOTOR DRIVEN



CHARACTERISTIC CURVE OF 6" DOUBLE SUCTION VOLUTE PUMP

Cameron Centrifugal Pumps

COUPLINGS: The coupling is of the flexible type of approved design, and of sufficient strength to safely transmit the power necessary to drive the pump, and is keyed to both ends of the shaft; the bolts connecting the two halves are placed inside of the rim to insure safety and prevent possible accidents.

PRIMING AND DRAIN CONNECTIONS: Suitable openings of proper size are provided at top and bottom of casing.

BEDPLATE: The bedplate is strong and of neat design, extending under pump and driving apparatus.

TESTING: Every pump is thoroughly tested for the specified working conditions before leaving our factory, and is guaranteed to meet them.

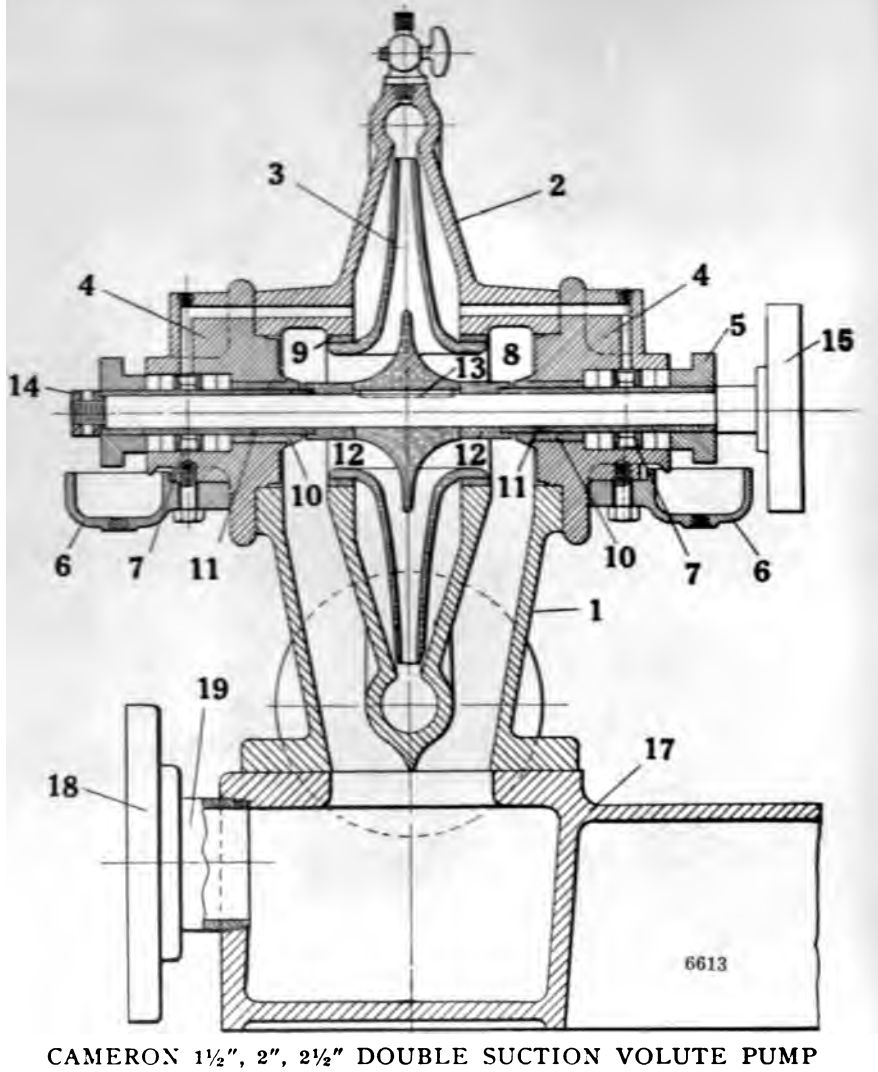
MATERIAL: All material used in the construction of the pump is the best of its kind, and of ample thickness and strength to withstand the wear and the working strain it will be subjected to.

PAINTING: The interior surfaces receive one coat of anti-rust paint. The exterior parts are rubbed smooth and receive one coat of filler and two coats of paint.

GUARANTEE AND WORKMANSHIP: The pump is guaranteed for one year against any defects due to faulty material or workmanship, and perfect parts will be supplied without charge for any that may prove to be defective.

Cameron Double Suction Volute Pumps

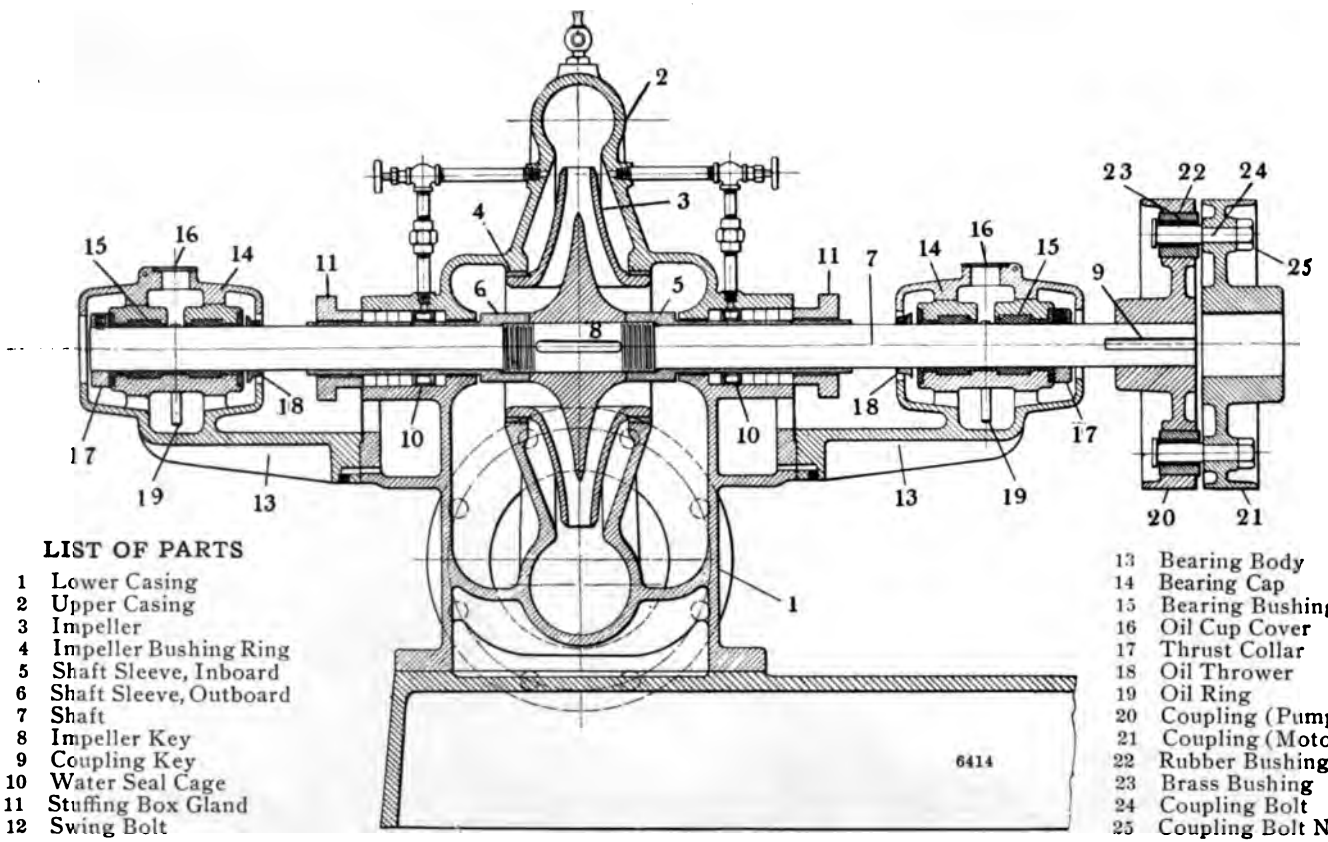
Size	Minimum Capacity G. P. M.	Maximum Capacity G. P. M.	Diameter Suction	Diameter Discharge	Overall Dimensions Pump Only			Code
					Length	Width	Height	
1½	50	75	2½	1½	1′-11¼″	1′-1⅞″	1′-2 ″	
2	80	125	3	2	1′-11¾″	1′-3 ″	1′-3 ″	
2½	125	175	3½	2½	2′- 1½″	1′-4½″	1′-4½″	
3	200	300	4	3	2′- 8¾″	1′-8 ″	1′-6½″	
4	300	525	5	4	3′- 5¼″	2′- ¼″	1′-10″	
5	550	850	6	5	3′- 6⅛″	2′-2¼″	2′- ¼″	
6	900	1200	8	6	4′- 1½″	2′-5 ″	2′-3 ″	
8	1500	2100	10	8	4′- 3½″	2′-7¾″	2′-5½″	
10	2500	3200	12	10	4′- 9¾″	3′-2½″	3′-	
12	3500	4500	14	12	4′-11½″	3′-6 ″	3′-5 ″	
14	5000	6000	16	14	5′- 1 ″	3′-8 ″	3′-8½″	
16	6000	7500	18	16	5′-10 ″	4′-4 ″	4′-3 ″	



CAMERON 1½", 2", 2½" DOUBLE SUCTION VOLUTE PUMP
SECTIONAL ELEVATION

LIST OF PARTS

1 Lower Casing
2 Upper Casing
3 Impeller
4 Stuffing Box
5 Stuffing Box Gland
6 Drip Pan
7 Water Seal Cage
8 Shaft
9 Impeller Bushing Ring
10 Stuffing Box Bushing
11 Shaft Sleeve
12 Distance Piece
13 Impeller Key
14 Shaft Nut
15 Coupling Pump End
16 Coupling Motor End
17 Bet Plate and Suction Box
18 Suction Flange
19 Suction Pipe



LIST OF PARTS

1 Lower Casing
2 Upper Casing
3 Impeller
4 Impeller Bushing Ring
5 Shaft Sleeve, Inboard
6 Shaft Sleeve, Outboard
7 Shaft
8 Impeller Key
9 Coupling Key
10 Water Seal Cage
11 Stuffing Box Gland
12 Swing Bolt
13 Bearing Body
14 Bearing Cap
15 Bearing Bushing
16 Oil Cup Cover
17 Thrust Collar
18 Oil Thrower
19 Oil Ring
20 Coupling (Pump End)
21 Coupling (Motor End)
22 Rubber Bushing
23 Brass Bushing
24 Coupling Bolt
25 Coupling Bolt Nut

SECTIONAL VIEW OF CAMERON DOUBLE SUCTION VOLUTE PUMP —SIZES 3" to 16" INCLUSIVE

Centrifugal Pumps do not need heavy foundations, but they must be strong enough to support the pumps firmly, and to avoid vibration due to possible shocks. Foundation bolts should not be set rigidly until the pump is placed in position.

The pump may then be aligned, the correctness of which may be determined by placing a level along the coupling flanges of pump and motor shaft. It will then be ready for grouting. After the grouting is set the foundation bolts may be tightened.

Suction and discharge piping must be self-supporting, and care should be taken not to strain the pump casing when connecting it to the pump.

It is advisable to make suction and discharge piping one or two sizes larger and connect same to the pump by means of increasers. There is a decided advantage in doing this, for it effects a saving in power and provides for a gain in pressure and an increased suction lift, if necessary. In laying the suction pipe line care should be taken also to avoid the formation of air pockets. If such are unavoidable the highest points must be evacuated at all times. A suitable check valve should be put on the discharge line close to the pump.

Before starting the pump the bearings and stuffing boxes should be examined and cleaned. Use only soft graphite packing in the stuffing boxes and do not pack too tight. Let a small amount of water seep through the boxes to avoid burning the packing. The necessary water supply can be regulated by the valves placed in water seal piping. This water serves also to seal the stuffing box and prevents air leaking through it.

The impeller of a Centrifugal Pump running in air cannot create sufficient vacuum to be self-priming. Therefore, all pumps not submerged must be primed to start. The priming can be effected by closing the discharge gate valve and exhausting the air by means of an ejector, or if suction pipe is fitted with a foot valve it may be filled with water from some suitable source and the air allowed to escape through an air cock on top of casing.

When the pump is fully primed it is ready to be started, in which case the pump should be brought up to its proper speed, and the discharge valve opened. After this the pump will need very little attention except an occasional inspection of the bearings, in which oil should be renewed from time to time. It is best to use a good quality of dynamo oil for lubricating the bearings.

The presence of air or gases in the suction line will considerably decrease the capacity and pressure. Care should be taken to avoid its entering the suction line by proper baffling or some other approved method.

When pumping any liquids having corrosive action on metals, the pump will be made of a special metal, but it will be necessary in such cases to occasionally inspect the interior of the pump and its working parts.

Friction of Water

Capacity in Gallons per Minute at Velocities of 1 to 15 Feet per Second.
Velocity Heads in Feet. Loss of Head in Feet per 100 Feet of Pipe.

Velocity	Velocity Head in Feet	1" Pipe		1¼" Pipe		1½" Pipe		2" Pipe		2½" Pipe		Velocity
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	2.9	.96	4.7	.62	6.4	.51	11.0	.50	17.4	.40	1
2	.06	5.00	2.65	9.4	2.2	12.7	1.88	20.0	1.52	31.0	1.15	2
3	.14	7.31	7.5	14.1	4.7	19.1	4.0	29.4	3.10	47.0	2.5	3
4	.25	9.82	13.0	18.8	8.1	25.3	6.7	39.2	5.3	61.0	4.0	4
5	.39	12.30	19.5	23.3	12.0	31.8	10.2	48.9	8.0	76.5	6.1	5
6	.56	14.70	27.5	28.0	16.8	38.2	14.4	58.7	11.2	92.0	8.6	6
7	.76	17.10	36.0	32.8	22.5	44.5	19.1	68.5	14.9	107.0	11.4	7
8	1.0	19.60	46.5	37.5	29.0	51.0	24.5	78.3	19.0	122.0	14.5	8
8.5	1.12	20.80	52.0	39.8	32.0	54.0	27.5	83.2	21.2	130.0	16.3	8.5
9	1.25	22.00	58.0	42.2	36.0	57.5	30.5	88.0	23.7	138.0	18.3	9
9.5	1.4	23.30	64.0	44.6	40.0	60.5	33.5	93.5	26.4	145.0	20.0	9.5
10	1.55	24.50	71.0	47.0	44.0	64.0	37.5	98.0	28.8	153.0	22.2	10
10.5	1.7	25.70	77.0	48.4	46.5	66.8	40.5	103.0	31.7	161.0	24.5	10.5
11	1.87	26.90	84.0	51.7	52.0	70.0	44.0	108.0	34.5	168.0	26.3	11
11.5	2.05	28.20	91.0	54.0	57.0	73.5	48.5	113.0	37.3	176.0	28.7	11.5
12	2.23	29.40	99.0	56.3	61.0	76.5	52.0	117.0	40.0	184.0	31.2	12
13	2.62	31.80	115.0	60.8	71.0	82.5	60.0	127.0	46.5	199.0	36.0	13
14	3.03	34.30	132.0	65.6	81.0	89.0	69.0	139.0	55.0	214.0	41.0	14
15	3.48	36.70	148.0	70.0	92.0	95.0	78.0	149.0	62.0	230.0	47.0	15

Velocity	Velocity Head in Feet	3" Pipe		4" Pipe		5" Pipe		6" Pipe		8" Pipe		10" Pipe		Velocity
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	24	.30	40	.20	68	.17	98	.13	156	.08	250	.05	1
2	.06	47	1.0	80	.52	128	.54	176	.40	312	.28	495	.23	2
3	.14	66	1.9	117	1.35	184	1.07	264	.86	470	.51	735	.47	3
4	.25	81	2.8	156	2.32	245	1.82	353	1.48	627	1.05	980	.81	4
5	.39	110	3.5	196	3.57	306	2.75	440	2.20	783	1.58	1225	1.27	5
6	.56	132	4.9	236	4.98	367	3.80	528	3.10	940	2.22	1470	1.70	6
7	.76	154	9.2	275	6.7	428	5.0	617	4.13	1005	2.95	1715	2.28	7
8	1.0	176	11.8	314	8.5	490	6.5	706	5.3	1255	3.78	1960	2.9	8
8.5	1.12	187	13.2	334	9.5	521	7.3	749	5.9	1330	4.23	2080	3.28	8.5
9	1.25	198	14.7	352	10.5	551	8.1	794	6.6	1410	4.7	2205	3.63	9
9.5	1.4	209	16.2	372	11.6	581	9.0	837	7.2	1490	5.2	2325	4.0	9.5
10	1.55	220	18.0	391	12.7	612	9.9	882	8.0	1565	5.7	2450	4.4	10
10.5	1.7	231	19.5	411	14.1	642	10.8	925	8.8	1645	6.2	2570	4.8	10.5
11	1.87	242	21.3	431	15.3	673	11.8	970	9.6	1725	6.8	2695	5.2	11
11.5	2.05	253	23.2	450	16.6	704	12.8	1013	10.3	1800	7.4	2815	5.7	11.5
12	2.23	264	25.0	471	18.0	735	13.8	1060	11.2	1880	8.0	2940	6.2	12
13	2.62	286	29.0	510	21.0	796	16.1	1145	13.0	2035	9.2	3130	6.9	13
14	3.03	308	33.5	549	24.0	857	18.4	1235	14.9	2195	10.7	3470	8.4	14
15	3.48	330	38.0	587	27.0	918	21.0	1320	16.8	2350	12.1	3670	9.3	15

Entrance head equals .5 times velocity head.
Calculated from Hazen-Williams Formula for C = 110 const.

Friction of Water

Capacity in Gallons per Minute at Velocities of 1 to 15 Feet per Second.
Velocity Heads in Feet. Loss of Head in Feet per 100 Feet of Pipe.

Velocity	Velocity Head in Feet	12" Pipe		14" Pipe		16" Pipe		18" Pipe		20" Pipe		24" Pipe		Velocity Feet per Second
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	350	.05	480	.03	630	.02	795	.02	965	.02	1410	.02	1
2	.06	705	.18	960	.10	1260	.13	1585	.11	1955	.10	2825	.08	2
3	.14	1060	.38	1450	.32	1890	.27	2380	.24	2940	.21	4230	.17	3
4	.25	1410	.65	1940	.55	2630	.47	3175	.40	3920	.36	5640	.29	4
5	.39	1765	.98	2420	.82	3160	.72	3965	.61	4900	.52	7050	.44	5
6	.56	2115	1.38	2900	1.17	3780	1.0	4760	.86	5875	.76	8460	.61	6
7	.76	2470	1.83	3380	1.55	4420	1.33	5550	1.15	6855	1.0	9870	.82	7
8	1.0	2820	2.35	3870	2.0	5050	1.7	6345	1.46	7835	1.28	11280	1.05	8
8.5	1.12	3000	2.63	4120	2.35	5360	1.9	6740	1.64	8325	1.45	11980	1.17	8.5
9	1.25	3175	2.92	4350	2.47	5680	2.12	7140	1.82	8810	1.65	12690	1.3	9
9.5	1.40	3350	3.25	4600	2.75	6000	2.35	7535	2.0	9300	1.77	13400	1.43	9.5
10	1.55	3525	3.55	4830	3.0	6300	2.55	7930	2.22	9790	1.95	14100	1.58	10
10.5	1.70	3700	3.9	5070	3.3	6630	2.83	8330	2.42	10280	2.15	14800	1.72	10.5
11	1.87	3880	4.25	5320	3.6	6950	3.10	8725	2.65	10770	2.3	15500	1.88	11
11.5	2.05	4055	4.6	5550	3.9	7250	3.32	9120	2.87	11260	2.53	16220	2.05	11.5
12	2.23	4230	5.0	5800	4.25	7570	3.62	9520	3.10	11750	2.70	16920	2.20	12
13	2.62	4585	5.8	6290	4.9	8220	4.2	10310	3.6	12730	3.16	18330	2.55	13
14	3.03	4935	6.6	6770	5.6	8840	4.8	11105	4.1	13700	3.63	19740	2.93	14
15	3.48	5290	7.5	7250	6.2	9450	5.4	11900	4.67	14690	4.15	21150	3.33	15

Velocity	Velocity Head in Feet	30" Pipe		36" Pipe		42" Pipe		48" Pipe		54" Pipe		Velocity Feet per Second
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	2200	.01	3120	.01	4320	.01	5700	.01	7140	.01	1
2	.06	4400	.06	6240	.05	8640	.04	11280	.03	14280	.03	2
3	.14	6610	.13	9520	.10	12960	.08	16920	.07	21420	.05	3
4	.25	8815	.22	12700	.18	17270	.15	22560	.13	28550	.11	4
5	.39	11015	.35	15860	.27	21590	.22	28200	.19	35690	.17	5
6	.56	13220	.47	19040	.38	25910	.32	33850	.27	42830	.23	6
7	.76	15420	.63	22200	.50	30230	.42	39480	.36	49970	.31	7
8	1.0	17620	.81	25380	.65	34550	.54	45120	.46	57100	.40	8
8.5	1.12	18730	.90	26970	.73	36700	.60	47940	.52	60680	.45	8.5
9	1.25	19830	1.0	28550	.81	38860	.68	50760	.58	64250	.52	9
9.5	1.40	20930	1.12	30140	.89	41020	.75	53580	.64	67810	.56	9.5
10	1.55	22030	1.22	31730	.98	43180	.82	56400	.70	71380	.61	10
10.5	1.70	23130	1.33	33310	1.08	45340	.90	59220	.77	74950	.67	10.5
11	1.87	24230	1.44	34900	1.18	47500	.98	62040	.84	78520	.73	11
11.5	2.05	25340	1.58	36490	1.28	49660	1.07	64860	.91	82090	.80	11.5
12	2.23	26440	1.72	38070	1.38	51820	1.15	67680	.98	85660	.86	12
13	2.62	28640	1.97	41210	1.6	56140	1.34	73320	1.14	92800	1.0	13
14	3.03	30840	2.26	44420	1.83	60460	1.53	78960	1.32	99940	1.15	14
15	3.48	33050	2.58	46590	2.00	64780	1.73	84600	1.48	107080	1.30	15

Entrance head equals .5 times velocity head.
Calculated from Hazen-Williams Formula for C = 110 const.

*Table of Theoretical Horse-power Required to Raise Water to Different Heights

Gallons per Minute \ Feet	5	10	15	20	25	30	35	40	45	50	60	75	90	100
5	.006	.012	.019	.025	.031	.037	.044	.05	.06	.06	.07	.09	.11	.12
10	.012	.025	.037	.050	.062	.075	.087	.10	.11	.12	.15	.19	.22	.25
15	.019	.037	.056	.075	.094	.112	.131	.15	.17	.19	.22	.28	.34	.37
20	.025	.050	.075	.100	.125	.150	.175	.20	.22	.25	.30	.37	.45	.50
25	.031	.062	.093	.125	.156	.187	.219	.25	.28	.31	.37	.47	.56	.62
30	.037	.075	.112	.150	.187	.225	.262	.30	.34	.37	.45	.56	.67	.77
35	.043	.087	.131	.175	.219	.262	.306	.35	.39	.44	.52	.66	.79	.85
40	.050	.100	.150	.200	.250	.300	.350	.40	.45	.50	.60	.75	.90	1.00
45	.056	.112	.168	.225	.281	.335	.391	.45	.51	.56	.67	.84	1.01	1.12
50	.062	.125	.187	.250	.312	.375	.437	.50	.56	.62	.75	.94	1.12	1.25
60	.075	.150	.225	.300	.375	.450	.525	.60	.67	.75	.90	1.12	1.35	1.50
75	.093	.187	.281	.375	.469	.562	.656	.75	.84	.94	1.12	1.40	1.69	1.87
90	.112	.225	.337	.450	.562	.675	.787	.90	1.01	1.12	1.35	1.68	2.02	2.25
100	.125	.250	.375	.500	.625	.750	.875	1.00	1.12	1.25	1.50	1.87	2.25	2.50
125	.156	.312	.469	.625	.781	.937	1.094	1.25	1.41	1.56	1.87	2.34	2.81	3.12
150	.187	.375	.562	.750	.937	1.125	1.312	1.50	1.69	1.87	2.25	2.81	3.37	3.75
175	.219	.437	.656	.875	1.098	1.312	1.531	1.75	1.97	2.19	2.62	3.28	3.94	4.37
200	.250	.500	.750	1.000	1.250	1.500	1.750	2.00	2.25	2.50	3.00	3.75	4.50	5.00
250	.312	.625	.937	1.250	1.562	1.875	2.187	2.50	2.81	3.12	3.75	4.69	5.62	6.25
300	.375	.750	1.125	1.500	1.875	2.250	2.625	3.00	3.37	3.75	4.50	5.62	6.75	7.50
350	.437	.875	1.312	1.750	2.187	2.625	3.062	3.50	3.94	4.37	5.25	6.56	7.87	8.75
400	.500	1.000	1.500	2.000	2.500	3.000	3.500	4.00	4.50	5.00	6.00	7.50	9.00	10.00
500	.625	1.250	1.875	2.500	3.125	3.750	4.375	5.00	5.62	6.25	7.50	9.37	11.25	12.50

† Loss of Head in 90° Bends—Entrance Head in Feet for Velocities of 1 to 15 Feet per Second.

Velocity Feet per Second	1	2	3	4	5	6	7	8	8.5	9	9.5	10	10.5	11	11.5	12	13	14	15
Loss of Head in Feet, $\frac{r}{R} = 1$	.015	.061	.138	.247	.384	.555	.753	.985	1.11	1.25	1.35	1.53	1.69	1.86	2.02	2.22	2.59	3.02	3.47
Loss of Head in Feet, $\frac{r}{R} = \frac{1}{2}$	.003	.009	.021	.036	.057	.082	.11	.15	.17	.19	.21	.23	.25	.27	.30	.33	.38	.45	.51
Entrance Head in Feet	.01	.03	.07	.13	.195	.28	.38	.50	.57	.63	.70	.78	.85	.93	1.02	1.12	1.31	1.51	1.75

r = internal radius of pipe;

R = radius of curvature of axis of pipe.

*Allowances should be made for friction.

†Figured from Weisbach's rule for bends.

Pressure of Water

The pressure of water in pounds per square inch for every foot in height to 260 feet; and then, by intervals, to 3,000 feet head. By this table, from the pounds pressure per square inch, the feet head is readily obtained and vice versa.

Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch
1	0.43	54	23.39	107	46.34	160	69.31	213	92.20	285	123.45
2	0.86	55	23.82	108	46.78	161	69.74	214	92.69	290	125.62
3	1.30	56	24.26	109	47.21	162	70.17	215	93.13	295	127.78
4	1.73	57	24.69	110	47.64	163	70.61	216	93.56	300	129.95
5	2.16	58	25.12	111	48.08	164	71.04	217	93.99	305	132.12
6	2.59	59	25.55	112	48.51	165	71.47	218	94.43	310	134.28
7	3.03	60	25.99	113	48.94	166	71.91	219	94.86	315	136.46
8	3.46	61	26.42	114	49.38	167	72.34	220	95.30	320	138.62
9	3.89	62	26.85	115	49.81	168	72.77	221	95.73	325	140.79
10	4.33	63	27.29	116	50.24	169	73.20	222	96.16	330	142.95
11	4.76	64	27.72	117	50.68	170	73.64	223	96.60	335	145.12
12	5.20	65	28.15	118	51.11	171	74.07	224	97.03	340	147.28
13	5.63	66	28.58	119	51.54	172	74.50	225	97.46	345	149.45
14	6.06	67	29.02	120	51.98	173	74.94	226	97.90	350	151.61
15	6.49	68	29.45	121	52.41	174	75.37	227	98.33	355	153.78
16	6.93	69	29.88	122	52.84	175	75.80	228	98.76	360	155.94
17	7.36	70	30.32	123	53.28	176	76.23	229	99.20	365	158.10
18	7.79	71	30.75	124	53.71	177	76.67	230	99.63	370	160.27
19	8.22	72	31.18	125	54.15	178	77.10	231	100.0	375	162.45
20	8.66	73	31.62	126	54.58	179	77.53	232	100.49	380	164.61
21	9.09	74	32.05	127	55.01	180	77.97	233	100.93	385	166.78
22	9.53	75	32.48	128	55.44	181	78.40	234	101.36	390	168.94
23	9.96	76	32.92	129	55.88	182	78.84	235	101.70	395	171.11
24	10.39	77	33.35	130	56.31	183	79.27	236	102.23	400	173.27
25	10.82	78	33.78	131	56.74	184	79.70	237	102.66	425	184.10
26	11.26	79	34.21	132	57.18	185	80.14	238	103.09	450	195.0
27	11.69	80	34.65	133	57.61	186	80.57	239	103.53	475	205.77
28	12.12	81	35.08	134	58.04	187	81.0	240	103.96	500	216.58
29	12.55	82	35.52	135	58.48	188	81.43	241	104.39	525	227.42
30	12.99	83	35.95	136	58.91	189	81.87	242	104.83	550	238.25
31	13.42	84	36.39	137	59.34	190	82.30	243	105.26	575	249.09
32	13.86	85	36.82	138	59.77	191	82.73	244	105.69	600	259.90
33	14.29	86	37.25	139	60.21	192	83.17	245	106.13	625	270.73
34	14.72	87	37.68	140	60.64	193	83.60	246	106.56	650	281.56
35	15.16	88	38.12	141	61.07	194	84.03	247	106.99	675	292.40
36	15.59	89	38.55	142	61.51	195	84.47	248	107.43	700	303.22
37	16.02	90	38.98	143	61.94	196	84.90	249	107.86	725	314.05
38	16.45	91	39.42	144	62.37	197	85.33	250	108.29	750	324.88
39	16.89	92	39.85	145	62.81	198	85.76	251	108.73	775	335.72
40	17.32	93	40.28	146	63.24	199	86.20	252	109.16	800	346.54
41	17.75	94	40.72	147	63.67	200	86.63	253	109.59	825	357.37
42	18.19	95	41.15	148	64.10	201	87.07	254	110.03	850	368.20
43	18.62	96	41.58	149	64.54	202	87.50	255	110.46	875	379.03
44	19.05	97	42.01	150	64.97	203	87.93	256	110.89	900	389.86
45	19.49	98	42.45	151	65.40	204	88.36	257	111.32	925	400.70
46	19.92	99	42.88	152	65.84	205	88.80	258	111.76	950	411.54
47	20.35	100	43.31	153	66.27	206	89.21	259	112.19	975	422.35
48	20.79	101	43.75	154	66.70	207	89.66	260	112.62	1000	433.18
49	21.22	102	44.18	155	67.14	208	90.10	261	113.06	1500	649.7
50	21.65	103	44.61	156	67.57	209	90.53	262	113.49	2000	866.3
51	22.09	104	45.05	157	68.0	210	90.96	270	116.96	3000	1,299.5
52	22.52	105	45.48	158	68.43	211	91.39	275	119.12		
53	22.95	106	45.91	159	68.87	212	91.83	280	121.29		

Data Required for Estimates

Kindly answer the following questions as fully as possible:

1. Number of pumps required.....
2. Capacity of each pump.....gallons per minute.
3. Total lift, including discharge, suction and pipe friction.....feet.
4. Suction lift and distance from supply.....
5. Variation in lift, both discharge and suction, if any.....
6. Pump to be horizontal.....vertical.....
7. Quality of liquid—fresh water, gritty, acidulous, solids in suspension?.....
8. Temperature of liquid.....°Fahr. Specific gravity.....
9. Service continuous.....Intermittent.....

MOTIVE POWER

10. Direct-connected to motor. Direct current, voltage.....
    Alternating current, voltage.....Cycles.....Phase
11. Direct-connected to steam turbine. Steam pressure.....
    Condensing.....Non-Condensing.....
12. Direct-connected to steam engine. Steam pressure.....
    Condensing.....Non-Condensing.....
13. Belted—Give speed of motive power.....
14. Motive power furnished by purchaser.....By builder.....
15. Position of suction and discharge, right or left hand? (See note)
16. Remarks.....

(Complete this sheet, detach and forward it with your inquiry)

NOTE—The Cameron Double Suction Centrifugal Pump has a fixed nozzle position, but can be mounted right or left-hand.

When standing at the end opposite coupling end, and the direction of rotation is clock-wise or towards the discharge outlet, the pump is right-hand.

Unless otherwise stated, a right-hand pump will be furnished.

Data Required for Estimates

Kindly answer the following questions as fully as possible:

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2. Capacity of each pump.....gallons per minute.
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5. Variation in lift, both discharge and suction, if any.....
6. Pump to be horizontal.....vertical.....
7. Quality of liquid—fresh water, gritty, acidulous, solids in suspension?.....
8. Temperature of liquid.....°Fahr. Specific gravity.....
9. Service continuous.....Intermittent.....

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Unless otherwise stated, a right-hand pump will be furnished.

Useful Information—Water

One cubic inch weighs .0361 pounds.

One pound = 27.7 cubic inches.

One cubic foot = 62.4245 pounds at 39 degrees Fahr.; 7.48 gallons U. S.; 6.2321 gallons imperial.

One gallon U. S. = 8.33111 pounds; 231 cubic inches; .13368 cubic feet.

One imperial gallon = 10 pounds at 62 degrees Fahr.; 277.274 cubic inches; .16046 cubic feet.

One pound pressure = 2.31 feet in height.

One foot in height = .433 pounds pressure.

Petroleum weighs 6½ pounds per U. S. gallon, 42 gallons to the barrel.

To convert imperial gallons into U. S. gallons, multiply by the factor 1.2; to convert U. S. gallons into imperial gallons, multiply by the factor .8333.

A miner's inch is a measure for flow of water, and is the quantity of water that will flow in one minute through an opening one inch square in a plank 2 inches thick under a head of 6½ inches to the centre of the orifice. This is equivalent, approximately, to 1.53 cubic feet, or 11½ gallons per minute.

To find the horse-power necessary to elevate water to a given height, multiply the weight of the water elevated per minute by the height in feet and divide the product by 33,000 (an allowance should be made for water friction).

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inch, or a column of water 33.9 feet high at sea level.

The resistance of friction in the flow of water through pipes of uniform diameter is independent of the pressure and increases **directly** as the length and the square of the velocity of the flow, and **inversely** as the diameter of the pipe. With wooden pipes the friction is 1.75 times greater than in metallic. Doubling the diameter increases the capacity four times.

To determine the velocity in feet per minute necessary to discharge a given volume of water in a given time, multiply the number of cubic feet of water by 144 and divide the product by the area of the pipe in inches.

To determine the area of a required pipe, the volume and velocity of water being given, multiply the number of cubic feet of water by 144 and divide the product by the velocity in feet per minute.

Cameron Turbine Centrifugal Pumps

A. S. CAMERON STEAM PUMP WORKS
11 Broadway, New York

Bulletin No. 151 Jan. 1914

Cameron Centrifugal Pumps

The Slogan of the Cameron—
"CHARACTER: THE GRANDEST THING"

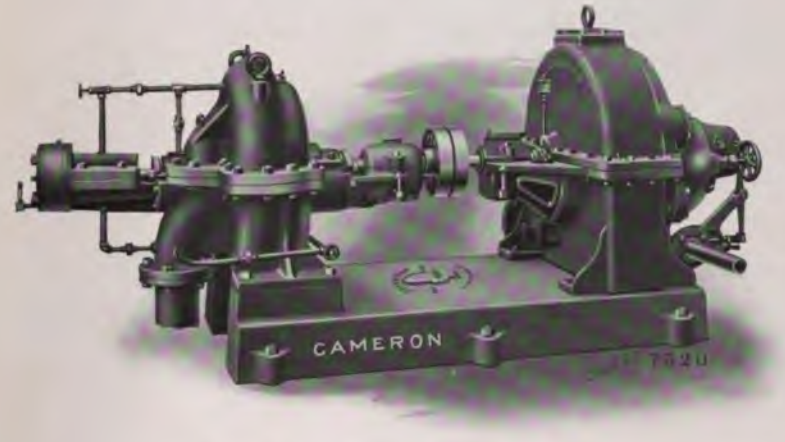
INTRODUCTION

Centrifugal Pumps fall naturally into two broad general classes—Low Head Pumps, which are usually of the single stage volute type, and then High Head Pumps, which are of the Multi-stage Turbine Centrifugal type.

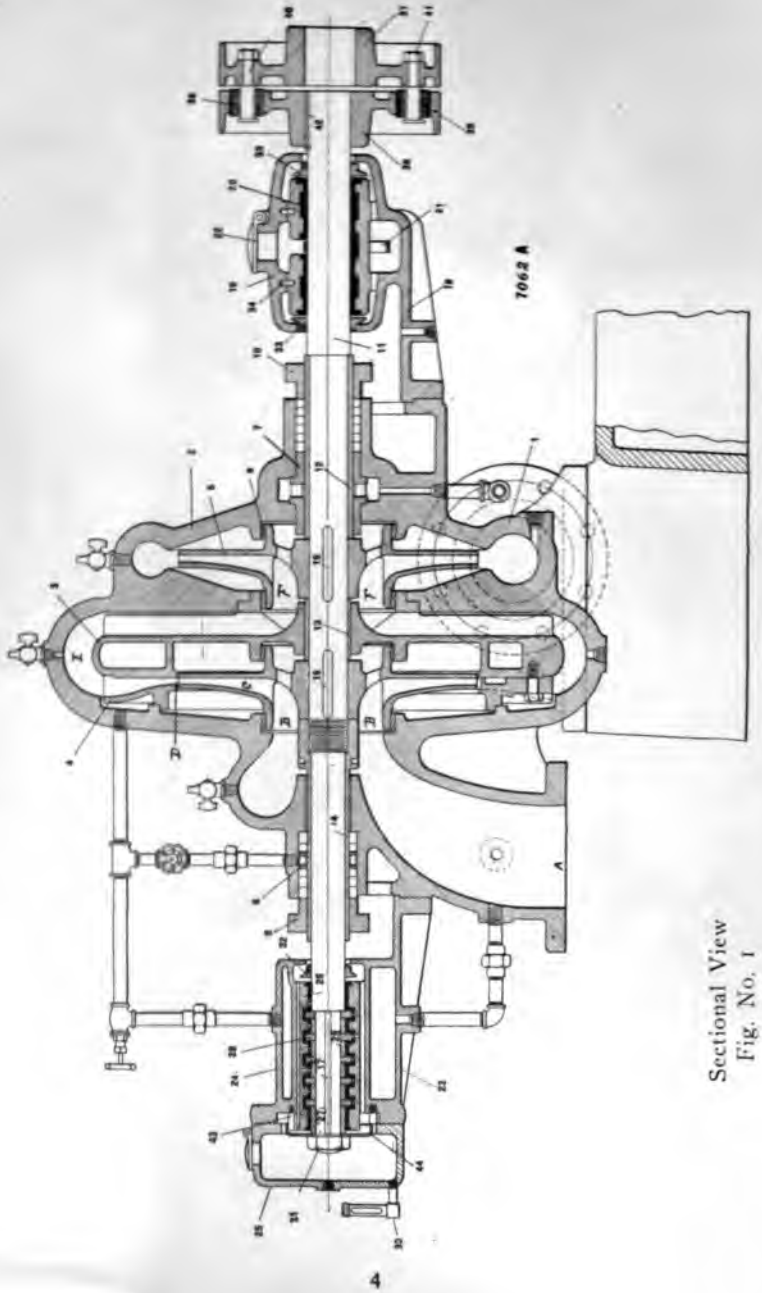
Now it is not possible to draw a fixed boundary line between the ranges of the single and multi-stage pumps, because the employment of either type is dependent on speed available, and head and capacity required. As a result, the fields of the two types overlap considerably.

We manufacture both High and Low Head Pumps. The Low Head Pumps of the double suction volute type are thoroughly described in Bulletin No. 150. The purpose of this publication is to give a complete description of the Cameron High Head or Multi-stage Turbine Centrifugal Pumps.

Two Stage Pump, Motor Driven



Two Stage Pump, Turbine Driven



Sectional View
Fig. No. 1

OPERATION

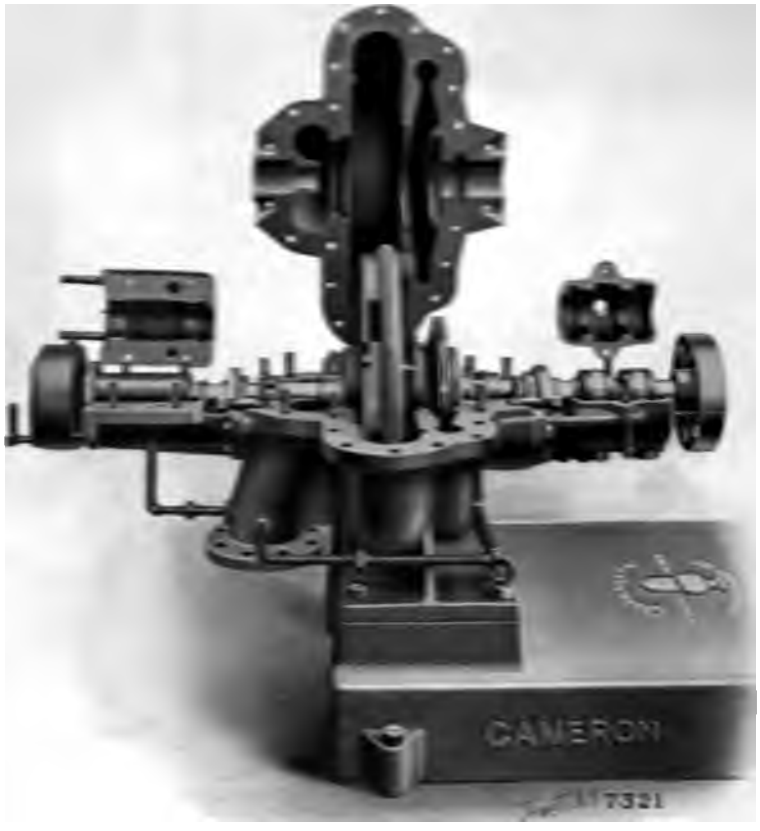
Figure No. 1 on page 4 illustrates a cross section of a two-stage horizontal Turbine Centrifugal Pump. Water enters the pump at point "A" and proceeds to the first impeller, which it enters at points "B". This impeller revolves at high speed and has curved radial passages "C", which connect with openings "B". On entering the impeller the water immediately comes under the influence of the centrifugal force resulting from the rotation of the impeller and is moved to the periphery at a gradually increasing speed. It finally leaves the impeller at high velocity and enters the diffusion vane 4 at point "D".

The function of these diffusion vanes is most important, and **no turbine pump can be built without this feature and give permanently satisfactory efficiency.**

The water enters "D" at high velocity, and we wish to convert this velocity into useful pressure with the least possible loss, at the same time reducing the velocity, so that the turn of 180 deg. at point "B" shall be accomplished without serious friction loss and without the water striking the surface at a velocity that would be destructive to the casing.

The diffusion vanes accomplish both these results. They form part of a stationary concentric ring, completely surrounding the impeller and containing a number of openings gradually increasing in area, so that at point "E" the velocity head is changed to pressure.

The water now flows at a reduced velocity, and with the pressure gained in the first stage, through the channel ring 3 enters the second impeller at point "F". Leaving the



Casing Open, Showing Access to Impeller

last impeller the water passes into a volute chamber of proper proportions, which it leaves at the predetermined pressure.

The diffusion vane is omitted here, as the water does not have to make the turn as in the preceding stage, and by making the volute chamber of proper design, the water cannot strike the casing at a troublesome speed. The omission of the vane in the last stage tends to increase the pressure, capacity and efficiency of the pump, at the same time simplifying the construction.

These pumps can be driven by any available motive power, and can be had in a great choice of speeds so that direct connection, with its attendant advantages, is usually possible. They are offered in two, three and four stages, suitable for heads up to 800 feet and in capacities up to 2,000 gallons per minute.

CONSTRUCTION

CASING: The casing is of cast iron, unless otherwise specified, although it can be made of other metals, such as bronze, to resist the action of corrosive fluids. It is in two parts, being divided along the horizontal center line. The fullest advantage of this construction is gained by placing both suction and discharge connections in the lower part of the casing; the upper half can thus be readily removed and full access obtained to the revolving element. Suitable openings are provided for draining the pump and for displacing air when starting.

CHANNEL RINGS: These are made of cast iron unless otherwise specified, accurately fitted, and smoothed to reduce friction of water.

SHAFT: The shaft of a centrifugal pump has very little weight to support, and is not usually subject to any shocks; still the duty is severe, as the horse-power and speed are frequently considerable, so it is important that the best material and workmanship be used. The shafts on Cameron Pumps are made of high grade forged steel accurately machined and then ground.

Revolving Element of Two Stage Pump

Wherever the shaft comes in contact with the fluid being pumped, it is thoroughly protected by bronze bushings 12, 13 and 14 (see Fig. 1). Bushings 12 and 14 have an additional duty to perform in preventing packing in the stuffing boxes from scoring the surface of the shaft.

Impeller

IMPELLERS: Each impeller is cast solid in one piece and is of the enclosed type. It consists practically of two discs separated by a series of curved ribs, or vanes, between which the water flows.

All accessible surfaces are carefully machined and polished, and where it is impossible to machine a surface, hand work is used to accomplish the same result, namely, a smooth surface to reduce the water friction.

Standard equipment calls for cast iron impellers, but bronze are recommended. Surrounding each side of the impeller hubs are broad flat rings made of bronze, which are secured in the casing. They prevent leakage from the high to the low pressure side of the impellers, and can be readily renewed at moderate cost.

DIFFUSION RING: The function of this part has been described in the first part of this bulletin. It is usually made of cast iron, but can be supplied of bronze if required. This ring is stationary, and completely surrounds the impeller. It contains a series of curved passages immediately opposite the impeller, which gradually increase in area outward. This increase of area changes the velocity head into pressure after the water leaves the impeller, and prevents it from striking the casing at a high speed which would cause excessive wear, a loss in pressure and a consequent loss of efficiency.

Diffusion Ring

THRUST BEARING: Thrust is an action which manifests itself in all Centrifugal Pumps. It is caused by unbalanced pressure created in various ways on the impeller. Of the various devices that have been contrived to take care of this, none has given such general satisfaction as the Marine thrust bearing, so called from being used on vessels to take care of the thrust of the screw propeller. We have, therefore, adopted this construction, and in improved form. The outboard end of shaft is reduced in diameter and on this portion is mounted a series of bushings, 28, and collars, 29, made of high carbon steel and accurately ground. By making these collars sep-

Thrust Bearing Details

arately instead of cutting them directly in the shaft as is usually done, it is possible to secure ample surface to absorb the thrust, and in the event of wear renewal is possible without delay and at a minimum cost.

These collars and bushings revolve in a babbit lined cast iron shell 26, which is split and readily renewable. This shell

fits in a housing 23 and 24, which is thoroughly water jacketed. At one end of the shaft there is secured a disc 44, which collects oil from the adjacent reservoir, and as the shaft revolves the oil is carried to the upper part of the thrust bearing cap, where it is caught and flows along to a series of oil holes supplying each compartment of the thrust bearing. This construction of bearing with cooling and lubricating device, is guaranteed to satisfactorily take care of the unbalanced thrust. The impellers have balancing holes cut in the hubs, which also assist the thrust bearing in its duty. The impellers are in perfect static and running balance.

INBOARD BEARING: This bearing is made in three diameters long and follows the best electric motor practice. It is automatically ring oiled and has removable split bushing 20, lined with best babbit metal. Oil throwers 33 prevent oil from being carried along the shaft.

Inboard Bearing Details

STUFFING BOXES: These are of ample depth to perform their function properly. The glands are provided with swing bolts, which can be swung aside when it is desired to take out the shaft or to renew packing.

The outboard stuffing box is equipped with a water seal cage 8, to prevent air leaks. This cage is supplied with water from the first stage.

FLEXIBLE COUPLING: To take care of any slight variation in alignment between pump and motive power, the coupling between the two is given a certain amount of flexibility. The coupling is in halves, one containing a series of pins 40, which engage a series of holes in the other half, that are bushed with brass lined soft rubber thimbles. The couplings are large and thoroughly shrouded to eliminate danger from revolving projections. When the pump is belt driven the coupling is omitted and replaced by a pulley properly supported by an outboard pedestal.

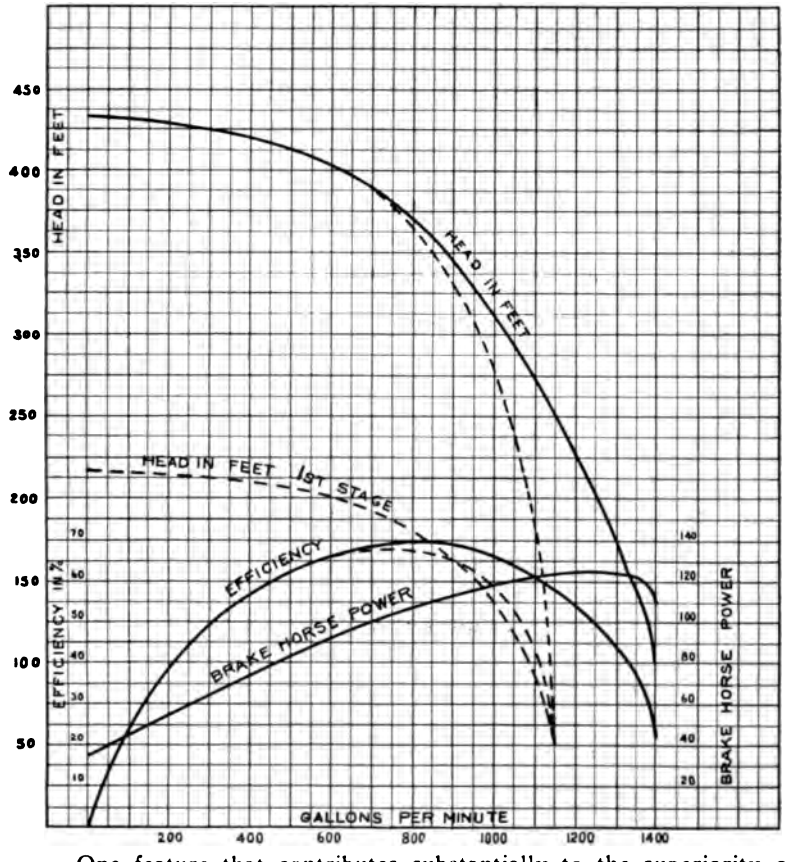
Flexible Coupling Details

BED PLATE: Unless otherwise ordered, each pump is supplied with a heavy bed plate, accurately machined and thoroughly ribbed to prevent distortion. This bed plate is in one piece, and is arranged to support also the electric motor, steam turbine, or other motive power, used for driving the pump.

GUARANTEE: Our usual guarantee as to workmanship and material accompanies these pumps, and they are further guaranteed to properly perform the duty for which they are designed.

In the following pages are given tables and general information, which will be of use to the engineer or prospective customer.

CHART—CHARACTERISTIC CURVE



One feature that contributes substantially to the superiority of the CAMERON TURBINE PUMP is the absence of the diffusion vane in the last stage of the pump. The effect of this is graphically shown in the above diagram where the full lines represent the behavior of the Cameron Turbine Pump, and the dotted lines the action of a pump having diffusion vanes in all the stages.

It is apparent that the Cameron Pump has a higher efficiency, and over a greater range of capacity. Higher pressures also are available on the over-capacity conditions and without overloading the motive power to any extent.

The question may be asked, why not omit vanes in all the stages? This point has already been discussed in the preceding pages. Suffice it to say that in all the stages but the last, the conditions to be met are radically different owing to the presence of a sharp curve in the path of the water on its way from one stage to another; in the last stage the water passes almost directly to the discharge line and the volute chamber properly adjusts the velocity, so that there is no loss from shock at this point.

FRICTION OF WATER

Capacity in Gallons per Minute at Velocities of 1 to 15 Feet per Second. Velocity Heads in Feet. Loss of Head in Feet per 100 Feet of Pipe.

Velocity	Velocity Head in Feet	1" Pipe		1¼" Pipe		1½" Pipe		2" Pipe		2½" Pipe		Velocity
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	2.9	.96	4.7	.62	6.4	.51	11.0	.50	17.4	.40	1
2	.06	5.00	2.65	9.4	2.2	12.7	1.88	20.0	1.52	31.0	1.15	2
3	.14	7.31	7.5	14.1	4.7	19.1	4.0	29.4	3.10	47.0	2.5	3
4	.25	9.82	13.0	18.8	8.1	25.3	6.7	39.2	5.3	61.0	4.0	4
5	.39	12.30	19.5	23.3	12.0	31.8	10.2	48.9	8.0	76.5	6.1	5
6	.56	14.70	27.5	28.0	16.8	38.2	14.4	58.7	11.2	92.0	8.6	6
7	.76	17.10	36.0	32.8	22.5	44.5	19.1	68.5	14.9	107.0	11.4	7
8	1.0	19.60	46.5	37.5	29.0	51.0	24.5	78.3	19.0	122.0	14.5	8
8.5	1.12	20.80	52.0	39.8	32.0	54.0	27.5	83.2	21.2	130.0	16.3	8.5
9	1.25	22.00	58.0	42.2	36.0	57.5	30.5	88.0	23.7	138.0	18.3	9
9.5	1.4	23.30	64.0	44.6	40.0	60.5	33 5	93.5	26.4	145.0	20.0	9.5
10	1.55	24.50	71.0	47.0	44.0	64.0	37.5	98.0	28.8	153.0	22.2	10
10.5	1.7	25.70	77.0	48.4	46.5	66.8	40.5	103.0	31.7	161.0	24.5	10.5
11	1.87	26.90	84.0	51.7	52.0	70.0	44.0	108.0	34.5	168.0	26.3	11
11.5	2.05	28.20	91.0	54.0	57.0	73.5	48.5	113.0	37.3	176.0	28.7	11.5
12	2.23	29.40	99.0	56.3	61.0	76.5	52.0	117.0	40.0	184.0	31.2	12
13	2.62	31.80	115.0	60.8	71.0	82.5	60.0	127.0	46.5	199.0	36.0	13
14	3.03	34.30	132.0	65.6	81.0	89.0	69.0	139.0	55.0	214.0	41.0	14
15	3.48	36.70	148.0	70.0	92.0	95.0	78.0	149.0	62.0	230.0	47.0	15

Velocity	Velocity Head in Feet	3" Pipe		4" Pipe		5" Pipe		6" Pipe		8" Pipe		10" Pipe		Velocity
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	24	.30	40	.20	68	.17	98	.13	156	.08	250	.05	1
2	.06	47	1.0	80	.52	128	.54	176	.40	312	.28	495	.23	2
3	.14	66	1.9	117	1.35	184	1.07	264	.86	470	.51	735	.47	3
4	.25	81	2.8	156	2.32	245	1.82	353	1.48	627	1.05	980	.81	4
5	.39	110	3.5	196	3.57	306	2.75	440	2.20	783	1.58	1225	1.27	5
6	.56	132	4.9	236	4.98	367	3.80	528	3.10	940	2.22	1470	1.70	6
7	.76	154	9.2	275	6.7	428	5.0	617	4.13	1005	2.95	1715	2.28	7
8	1.0	176	11.8	314	8.5	490	6.5	706	5.3	1255	3.78	1960	2.9	8
8.5	1.12	187	13.2	334	9.5	521	7.3	749	5.9	1330	4.23	2080	3.28	8.5
9	1.25	198	14.7	352	10.5	551	8.1	794	6.6	1410	4.7	2205	3.63	9
9.5	1.4	209	16.2	372	11.6	581	9.0	837	7.2	1490	5.2	2325	4.0	9.5
10	1.55	220	18.0	391	12.7	612	9.9	882	8.0	1565	5.7	2450	4.4	10
10.5	1.7	231	19.5	411	14.1	642	10.8	925	8.8	1645	6.2	2570	4.8	10.5
11	1.87	242	21.3	431	15.3	673	11.8	970	9.6	1725	6.8	2695	5.2	11
11.5	2.05	253	23.2	450	16.6	704	12.8	1013	10.3	1800	7.4	2815	5.7	11.5
12	2.23	264	25.0	471	18.0	735	13.8	1060	11.2	1880	8.0	2940	6.2	12
13	2.62	286	29.0	510	21.0	796	16.1	1145	13.0	2035	9.2	3130	6.9	13
14	3.03	308	33.5	549	24.0	857	18.4	1235	14.9	2195	10.7	3470	8.4	14
15	3.48	330	38.0	587	27.0	918	21.0	1320	16.8	2350	12.1	3670	9.3	15

Entrance head equals .5 times velocity head.
Calculated from Hazen-Williams Formula for C = 110 const.

FRICTION OF WATER

Capacity in Gallons per Minute at Velocities of 1 to 15 Feet per Second.
Velocity Heads in Feet. Loss of Head in Feet per 100 Feet of Pipe.

Velocity	Velocity Head in Feet	12" Pipe		14" Pipe		16" Pipe		18" Pipe		20" Pipe		24" Pipe		Velocity
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	350	.05	480	.03	630	.02	795	.02	965	.02	1410	.02	1
2	.06	705	.18	960	.10	1260	.13	1585	.11	1955	.10	2825	.08	2
3	.14	1060	.38	1450	.32	1890	.27	2380	.24	2940	.21	4230	.17	3
4	.25	1410	.65	1940	.55	2630	.47	3175	.40	3920	.36	5640	.29	4
5	.39	1765	.98	2420	.82	3160	.72	3965	.61	4900	.52	7050	.44	5
6	.56	2115	1.38	2900	1.17	3780	1.0	4760	.86	5875	.76	8460	.61	6
7	.76	2470	1.83	3380	1.55	4420	1.33	5550	1.15	6855	1.0	9870	.82	7
8	1.0	2820	2.35	3870	2.0	5050	1.7	6345	1.46	7835	1.28	11280	1.05	8
8.5	1.12	3000	2.63	4120	2.35	5360	1.9	6740	1.64	8325	1.45	11980	1.17	8.5
9	1.25	3175	2.92	4350	2.47	5680	2.12	7140	1.82	8810	1.65	12690	1.3	9
9.5	1.40	3350	3.25	4600	2.75	6000	2.35	7535	2.0	9300	1.77	13400	1.43	9.5
10	1.55	3525	3.55	4830	3.0	6300	2.55	7930	2.22	9790	1.95	14100	1.58	10
10.5	1.70	3700	3.9	5070	3.3	6630	2.83	8330	2.42	10280	2.15	14800	1.72	10.5
11	1.87	3880	4.25	5320	3.6	6950	3.10	8725	2.65	10770	2.3	15500	1.88	11
11.5	2.05	4055	4.6	5550	3.9	7250	3.32	9120	2.87	11260	2.53	16220	2.05	11.5
12	2.23	4230	5.0	5800	4.25	7570	3.62	9520	3.10	11750	2.70	16920	2.20	12
13	2.62	4585	5.8	6290	4.9	8220	4.2	10310	3.6	12730	3.16	18330	2.55	13
14	3.03	4935	6.6	6770	5.6	8840	4.8	11105	4.1	13700	3.63	19740	2.93	14
15	3.48	5290	7.5	7250	6.2	9450	5.4	11900	4.67	14690	4.15	21150	3.33	15

Velocity	Velocity Head in Feet	30" Pipe		36" Pipe		42" Pipe		48" Pipe		54" Pipe		Velocity
		Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	Gallons per Minute	Loss of Head in Feet	
1	.02	2200	.01	3120	.01	4320	.01	5700	.01	7140	.01	1
2	.06	4400	.06	6240	.05	8640	.04	11280	.03	14280	.03	2
3	.14	6610	.13	9520	.10	12960	.08	16920	.07	21420	.05	3
4	.25	8815	.22	12700	.18	17270	.15	22560	.13	28550	.11	4
5	.39	11015	.35	15860	.27	21590	.22	28200	.19	35690	.17	5
6	.56	13220	.47	19040	.38	25910	.32	33850	.27	42830	.23	6
7	.76	15420	.63	22200	.50	30230	.42	39480	.36	49970	.31	7
8	1.0	17620	.81	25380	.65	34550	.54	45120	.46	57100	.40	8
8.5	1.12	18730	.90	26970	.73	36700	.60	47940	.52	60680	.45	8.5
9	1.25	19830	1.0	28550	.81	38860	.68	50760	.58	64250	.52	9
9.5	1.40	20930	1.12	30140	.89	41020	.75	53580	.64	67810	.56	9.5
10	1.55	22030	1.22	31730	.98	43180	.82	56400	.70	71380	.61	10
10.5	1.70	23130	1.33	33310	1.08	45340	.90	59220	.77	74950	.67	10.5
11	1.87	24230	1.44	34900	1.18	47500	.98	62040	.84	78520	.73	11
11.5	2.05	25340	1.58	36490	1.28	49660	1.07	64860	.91	82090	.80	11.5
12	2.23	26440	1.72	38070	1.38	51820	1.15	67680	.98	85660	.86	12
13	2.62	28640	1.97	41210	1.6	56140	1.34	73320	1.14	92800	1.0	13
14	3.03	30840	2.26	44420	1.83	60460	1.53	78960	1.32	99940	1.15	14
15	3.48	33050	2.58	46590	2.00	64780	1.73	84600	1.48	107080	1.30	15

Entrance head equals .5 times velocity head.
Calculated from Hazen-Williams Formula for C = 110 const.

DIRECTIONS FOR INSTALLING AND OPERATING

All pumps not submerged must be primed to start, to avoid injuring the interior parts that require water for lubrication.

Centrifugal pumps do not need heavy foundations, but they must be strong enough to support the pumps firmly, and to avoid vibration due to possible shocks. Foundation bolts should not be set rigidly until the pump is placed in position.

The pump may then be aligned, the correctness of which may be determined by placing a level along the coupling flanges of pump and motor shaft. It will then be ready for grouting. After the grouting is set the foundation bolts may be tightened.

Suction and discharge piping must be self-supporting, and care should be taken not to strain the pump casing when connecting it to the pump.

It is advisable to make suction and discharge piping one or two sizes larger and connect same to the pump by means of increasers. There is a decided advantage in doing this, for it effects a saving in power and provides for a gain in pressure and an increased suction lift, if necessary. In laying the suction pipe line care should be taken also to avoid the formation of air pockets. If such are unavoidable the highest points must be evacuated at all times. A suitable check valve should be put on the discharge line close to the pump.

Before starting the pump the bearings and stuffing boxes should be examined and cleaned. Use only soft graphite packing in the stuffing boxes and do not pack too tight. Let a small amount of water seep through the boxes to avoid burning the packing. The necessary water supply can be regulated by the valves placed in water seal piping. This water serves also to seal the stuffing box and prevents air leaking through it.

The impeller of a Centrifugal Pump running in air cannot create sufficient vacuum to be self-priming. The priming can be effected by closing the discharge gate valve and exhausting the air by means of an ejector, or if suction pipe is fitted with a foot valve it may be filled with water from some suitable source and the air allowed to escape through an air cock on top of casing.

When the pump is fully primed it is ready to be started, in which case the pump should be brought up to its proper speed, and the discharge valve opened. After this the pump will need very little attention except an occasional inspection of the bearings, in which oil should be renewed from time to time. It is best to use a good quality of dynamo oil for lubricating the bearings.

The presence of air or gases in the suction line will considerably decrease the capacity and pressure. Care should be taken to avoid its entering the suction line by proper baffling or some other approved method.

When pumping any liquids having corrosive action on metals, the pump will be made of a special metal, but it will be necessary in such cases to occasionally inspect the interior of the pump and its working parts.

DATA REQUIRED FOR ESTIMATES

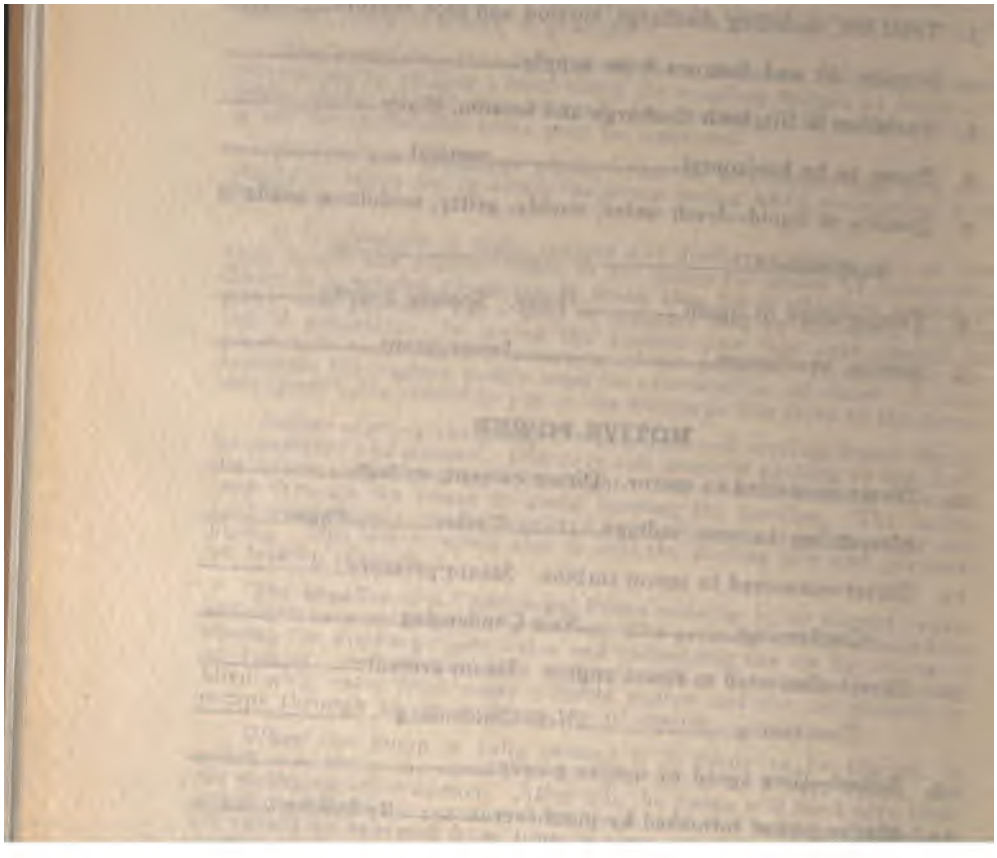
Kindly answer the following questions as fully as possible:

1. Number of pumps required_____
2. Capacity of each pump_____gallons per minute.
3. Total lift, including discharge, suction and pipe friction_____feet.
4. Suction lift and distance from supply_____
5. Variation in lift, both discharge and suction, if any_____
6. Pump to be horizontal_____vertical_____
7. Quality of liquid—fresh water, muddy, gritty, acidulous, solids in suspension?_____
8. Temperature of liquid_____°Fahr. Specific gravity_____
9. Service continuous_____Intermittent_____

MOTIVE POWER

10. Direct-connected to motor. Direct current, voltage_____
    Alternating current, voltage_____Cycles_____Phase_____
11. Direct-connected to steam turbine. Steam pressure_____
    Condensing_____Non-Condensing_____
12. Direct-connected to steam engine. Steam pressure_____
    Condensing_____Non-Condensing_____
13. Belted—Give speed of motive power_____
14. Motive power furnished by purchaser_____By builder_____
15. Position of suction and discharge, right or left hand?_____
16. Remarks_____

(Complete this sheet, detach and forward it with your inquiry)



DATA REQUIRED FOR ESTIMATES

Kindly answer the following questions as fully as possible:

1. Number of pumps required.....
2. Capacity of each pump.....gallons per minute.
3. Total lift, including discharge, suction and pipe friction.....feet.
4. Suction lift and distance from supply.....
5. Variation in lift, both discharge and suction, if any.....
6. Pump to be horizontal.....vertical.....
7. Quality of liquid—fresh water, muddy, gritty, acidulous, solids in suspension?.....
8. Temperature of liquid.....°Fahr. Specific gravity.....
9. Service continuous.....Intermittent.....

MOTIVE POWER

10. Direct-connected to motor. Direct current, voltage.....
    Alternating current, voltage.....Cycles.....Phase.....
11. Direct-connected to steam turbine. Steam pressure.....
    Condensing.....Non-Condensing.....
12. Direct-connected to steam engine. Steam pressure.....
    Condensing.....Non-Condensing.....
13. Belted—Give speed of motive power.....
14. Motive power furnished by purchaser.....By builder.....
15. Position of suction and discharge, right or left hand?.....
16. Remarks.....

(Complete this sheet, detach and forward it with your inquiry)

PRESSURE OF WATER

The pressure of water in pounds per square inch for every foot in height to 260 feet; and then, by intervals, to 3,000 feet head. By this table, from the pounds pressure per square inch, the feet head is readily obtained and vice versa.

Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch
1	0.43	54	23.39	107	46.34	160	69.31	213	92.20	285	123.45
2	0.86	55	23.82	108	46.78	161	69.74	214	92.69	290	125.62
3	1.30	56	24.26	109	47.21	162	70.17	215	93.13	295	127.78
4	1.73	57	24.69	110	47.64	163	70.61	216	93.56	300	129.95
5	2.16	58	25.12	111	48.08	164	71.04	217	93.99	305	132.12
6	2.59	59	25.55	112	48.51	165	71.47	218	94.43	310	134.28
7	3.03	60	25.99	113	48.94	166	71.91	219	94.86	315	136.46
8	3.46	61	26.42	114	49.38	167	72.34	220	95.30	320	138.62
9	3.89	62	26.85	115	49.81	168	72.77	221	95.73	325	140.79
10	4.33	63	27.29	116	50.24	169	73.20	222	96.16	330	142.95
11	4.76	64	27.72	117	50.68	170	73.64	223	96.60	335	145.12
12	5.20	65	28.15	118	51.11	171	74.07	224	97.03	340	147.28
13	5.63	66	28.58	119	51.54	172	74.50	225	97.46	345	149.45
14	6.06	67	29.02	120	51.98	173	74.94	226	97.90	350	151.61
15	6.49	68	29.45	121	52.41	174	75.37	227	98.33	355	153.78
16	6.93	69	29.88	122	52.84	175	75.80	228	98.76	360	155.94
17	7.36	70	30.32	123	53.28	176	76.23	229	99.20	365	158.10
18	7.79	71	30.75	124	53.71	177	76.67	230	99.63	370	160.27
19	8.22	72	31.18	125	54.15	178	77.10	231	100.0	375	162.45
20	8.66	73	31.62	126	54.58	179	77.53	232	100.49	380	164.61
21	9.09	74	32.05	127	55.01	180	77.97	233	100.93	385	166.78
22	9.53	75	32.48	128	55.44	181	78.40	234	101.36	390	168.94
23	9.96	76	32.92	129	55.88	182	78.84	235	101.70	395	171.11
24	10.39	77	33.35	130	56.31	183	79.27	236	102.23	400	173.27
25	10.82	78	33.78	131	56.74	184	79.70	237	102.66	425	184.10
26	11.26	79	34.21	132	57.18	185	80.14	238	103.09	450	195.0
27	11.69	80	34.65	133	57.61	186	80.57	239	103.53	475	205.77
28	12.12	81	35.08	134	58.04	187	81.0	240	103.96	500	216.58
29	12.55	82	35.52	135	58.48	188	81.43	241	104.39	525	227.42
30	12.99	83	35.95	136	58.91	189	81.87	242	104.83	550	238.25
31	13.42	84	36.39	137	59.34	190	82.30	243	105.26	575	249.09
32	13.86	85	36.82	138	59.77	191	82.73	244	105.69	600	259.90
33	14.29	86	37.25	139	60.21	192	83.17	245	106.13	625	270.73
34	14.72	87	37.68	140	60.64	193	83 60	246	106.56	650	281.56
35	15.16	88	38.12	141	61.07	194	84 03	247	106.99	675	292.40
36	15.59	89	38.55	142	61.51	195	84.47	248	107.43	700	303.22
37	16.02	90	38.98	143	61.94	196	84 90	249	107.86	725	314.05
38	16.45	91	39.42	144	62.37	197	85 33	250	108.29	750	324.88
39	16.89	92	39.85	145	62.81	198	85 76	251	108.73	775	335.72
40	17.32	93	40.28	146	63.24	199	86 20	252	109.16	800	346.54
41	17.75	94	40.72	147	63.67	200	86.63	253	109.59	825	357.37
42	18.19	95	41.15	148	64.10	201	87.07	254	110.03	850	368.20
43	18.62	96	41.58	149	64.54	202	87.50	255	110.46	875	379.03
44	19.05	97	42.01	150	64.97	203	87.93	256	110.89	900	389.86
45	19.49	98	42.45	151	65.40	204	88.36	257	111.32	925	400.70
46	19.92	99	42.88	152	65.84	205	88.80	258	111.76	950	411.54
47	20.35	100	43.31	153	66.27	206	89.21	259	112.19	975	422.35
48	20.79	101	43.75	154	66.70	207	89 66	260	112.62	1000	433.18
49	21.22	102	44.18	155	67.14	208	90.10	261	113.06	1500	649.7
50	21.65	103	44.61	156	67.57	209	90.53	262	113.49	2000	866.3
51	22.09	104	45.05	157	68.0	210	90.96	270	116.96	3000	1,299.5
52	22.52	105	45.48	158	68.43	211	91.39	275	119.12		
53	22.95	106	45.91	159	68.87	212	91.83	280	121.29		

THEORETICAL DISCHARGE OF NOZZLES IN U. S. GALLONS PER MINUTE

Head Lbs.	Head Feet	Velocity of Discharge in Feet per Second	DIAMETER OF NOZZLE IN INCHES												
			7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4
10	23.1	38.58	0.37	1.48	3.30	5.90	13.2	23.6	36.8	53.2	72.2	94.4	119	148	178
15	34.7	47.25	0.45	1.81	4.02	7.23	16.2	28.7	45.0	65.1	88.4	116	146	181	218
20	46.2	54.55	0.52	2.09	4.66	8.35	18.7	33.4	52.0	75.3	102	134	169	209	252
25	57.8	60.99	0.58	2.33	5.23	9.33	20.9	37.2	58.2	84.1	114	149	189	233	282
30	69.3	66.82	0.64	2.56	5.71	10.2	22.8	40.9	63.7	92.2	125	164	207	256	309
35	80.9	72.16	0.69	2.76	6.16	11.0	24.7	44.2	68.8	99.6	135	177	223	276	334
40	92.4	77.14	0.74	2.95	6.60	11.8	26.4	47.2	73.6	106	144	189	239	295	357
45	104.0	81.83	0.78	3.13	6.99	12.5	28.0	50.2	78.1	113	153	200	253	313	378
50	115.5	86.26	0.82	3.30	7.37	13.2	29.5	52.8	82.3	119	161	211	267	330	399
55	127.1	90.46	0.86	3.46	7.73	13.8	30.9	55.4	86.3	125	169	221	280	346	418
60	138.6	94.49	0.90	3.62	8.08	14.5	32.3	57.8	90.1	130	177	231	293	362	437
65	150.2	98.35	0.94	3.77	8.40	15.1	33.6	60.2	93.8	136	184	241	305	377	455
70	161.7	102.06	0.97	3.91	8.73	15.6	34.9	62.5	97.4	141	191	250	316	391	472
75	173.3	105.65	1.01	4.04	9.03	16.2	36.1	64.6	101	146	198	259	327	404	488
80	184.8	109.11	1.04	4.18	9.33	16.7	37.8	66.6	104	150	204	267	338	418	504
85	196.4	112.46	1.07	4.31	9.62	17.2	38.5	68.8	107	155	210	275	348	431	520
90	207.9	115.72	1.10	4.43	9.89	17.7	39.6	70.8	110	160	217	283	358	443	535
95	219.5	118.89	1.13	4.55	10.2	18.2	40.7	72.8	113	164	223	291	368	455	550
100	231.1	121.98	1.16	4.67	10.4	18.7	41.7	74.6	116	168	228	299	378	467	564
105	242.6	125.00	1.19	4.78	10.7	19.1	42.8	76.5	119	172	234	306	387	478	578
110	254.2	127.94	1.22	4.90	10.9	19.6	43.8	78.3	122	177	239	313	396	490	591
115	265.7	130.82	1.25	5.01	11.2	20.0	44.8	80.1	125	181	245	320	405	501	605
120	277.3	133.63	1.27	5.12	11.4	20.4	45.7	81.8	127	184	250	327	414	512	618
125	288.8	136.38	1.30	5.22	11.7	20.9	46.7	83.5	130	188	255	334	422	522	630
130	300.4	139.08	1.33	5.32	11.9	21.3	47.6	85.1	133	192	260	341	431	532	643

Lbs.	Feet	Second	1 3/4	1 7/8	2	2 1/4	2 1/2	2 3/4	3	3 1/2	4	4 1/2	5	5 1/2	6
10	23.1	38.58	212	289	378	478	590	715	850	1160	1512	1912	2360	2860	3400
15	34.7	47.25	260	354	463	586	723	880	1040	1420	1852	2344	2800	3520	4160
20	46.2	54.55	300	409	534	676	835	1018	1200	1640	2136	2700	3340	4072	4800
25	57.8	60.99	336	457	597	756	933	1138	1350	1828	2390	3024	3730	4582	5400
30	69.3	66.82	368	501	654	828	1022	1240	1480	2000	2616	3312	4088	4960	5920
35	80.9	72.16	397	541	707	895	1104	1340	1590	2160	2828	3580	4416	5360	6360
40	92.4	77.14	425	578	755	956	1180	1430	1700	2320	3020	3824	4720	5720	6800
45	104	81.83	450	613	801	1014	1252	1520	1800	2450	3200	4056	5000	6080	7200
50	115.5	86.26	475	646	845	1069	1320	1600	1900	2580	3380	4276	5280	6400	7600
55	127.1	90.46	498	678	886	1122	1385	1680	2000	2720	3544	4488	5540	6720	8000
60	138.6	94.49	520	708	925	1171	1446	1755	2080	2840	3700	4684	5784	7020	8320
65	150.2	98.35	542	737	963	1219	1506	1830	2165	2950	3850	4876	6024	7320	8660
70	161.7	102.06	562	765	999	1265	1561	1895	2250	3060	4000	5060	6244	7580	9000
75	173.3	105.65	582	792	1034	1309	1616	1960	2330	3170	4136	5236	6464	7840	9320
80	184.8	109.11	601	818	1068	1352	1669	2030	2404	3280	4272	5400	6676	8120	9616
85	196.4	112.46	620	843	1101	1394	1720	2080	2480	3380	4400	5576	6880	8320	9920
90	207.9	115.72	637	867	1133	1434	1770	2150	2540	3470	4532	5736	7080	8600	10160
95	219.5	118.89	655	891	1164	1474	1820	2200	2620	3560	4656	5896	7280	8800	10480
100	231.1	121.98	672	914	1194	1512	1866	2260	2700	3650	4776	6048	7464	9040	10800
105	242.6	125.00	688	937	1224	1549	1912	2320	2760	3750	4896	6200	7648	9280	11040
110	254.2	127.94	705	959	1253	1586	1957	2380	2820	3840	5012	6344	7828	9520	11280
115	265.7	130.82	720	980	1281	1621	2002	2430	2880	3920	5124	6484	8008	9720	11520
120	277.3	133.63	736	1001	1308	1656	2044	2480	2950	4004	5232	6624	8176	9920	11800
125	288.8	136.38	751	1022	1335	1691	2086	2540	3000	4100	5340	6764	8344	10160	12000
130	300.4	139.08	766	1042	1362	1724	2128	2580	3070	4160	5448	6896	8512	10320	12280

The actual quantity discharged by a nozzle will be less than above table. A well tapered smooth nozzle may be assumed to give about 94 per cent. of the values in the tables.

USEFUL INFORMATION—WATER

One cubic inch weighs .0361 pounds.

One pound = 27.7 cubic inches.

One cubic foot = 62.4245 pounds at 39 degrees Fahr.; 7.48 gallons U. S.; 6.2321 gallons Imperial.

One gallon U. S. = 8.33111 pounds; 231 cubic inches; .13368 cubic feet.

One imperial gallon = 10 pounds at 62 degrees Fahr.; 277.274 cubic inches; .16046 cubic feet.

One pound pressure = 2.31 feet in height.

One foot in height = .433 pounds pressure.

Petroleum weighs 6½ pounds per U. S. gallon, 42 gallons to the barrel.

To convert imperial gallons into U. S. gallons, multiply by the factor 1.2; to convert U. S. gallons into imperial gallons, multiply by the factor .8333.

A miner's inch is a measure for flow of water, and is the quantity of water that will flow in one minute through an opening one inch square in a plank 2 inches thick under a head of 6½ inches to the center of the orifice. This is equivalent, approximately, to 1.53 cubic feet, or 11½ gallons per minute.

To find the horse-power necessary to elevate water to a given height, multiply the weight of the water elevated per minute by the height in feet and divide the product by 33,000 (an allowance should be made for water friction).

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inch, or a column of water 33.9 feet high at sea level.

The resistance of friction in the flow of water through pipes of uniform diameter is independent of the pressure and increases **directly** as the length and the square of the velocity of the flow, and **inversely** as the diameter of the pipe. With wooden pipes the friction is 1.75 times greater than in metallic. Doubling the diameter increases the capacity four times.

To determine the velocity in feet per minute necessary to discharge a given volume of water in a given time, multiply the number of cubic feet of water by 144 and divide the product by the area of the pipe in inches.

To determine the area of a required pipe, the volume and velocity of water being given, multiply the number of cubic feet of water by 144 and divide the product by the velocity in feet per minute.

Cameron Centrifugal Pumps

A. S. CAMERON STEAM PUMP WORKS

11 Broadway, New York

Bulletin No. 152 January, 1914

CAMERON SINGLE SUCTION VOLUTE
CENTRIFUGAL PUMP

The Slogan of the Cameron—

"CHARACTER: THE GRANDEST THING"

INTRODUCTION

To meet the wide-spread demand for a thoroughly well made and efficient Centrifugal Pump that can be purchased at a moderate price, we have developed the line of Single Suction Open Impeller Pumps illustrated and described in this Bulletin.

These pumps are usually furnished for belting to steam engine, gas engine or some other form of prime mover, but we are prepared to furnish them, at short notice, mounted on heavy base plates and equipped with suitable coupling so that they can be direct connected to electric motors or steam engines.

While not high priced, they are carefully designed in every respect, of generous proportions, and of the best materials. The usual CAMERON guarantee accompanies each one. They are offered in sizes up to 12" for various capacities, and for heads up to 70 feet. The belt-driven pumps of all sizes will be carried in stock so that quick deliveries can be made.

CONSTRUCTION

CASING: The casing is volute in form, made of the best close grained cast iron, and the interior is machined opposite the impeller, which is also carefully finished so that clearance is reduced to a minimum and the efficiency greatly improved. The suction opening is central and the discharge can be placed to face horizontally, vertically or diagonally by swinging the casing on the supporting head.

SUPPORTING HEAD: The weight of the casing is supported by a cast iron head bolted centrally to the casing. This supporting head is provided with feet planed and drilled for fastening to bed plate. The stuffing box and inboard bearing are incorporated in this casting.

IMPELLER: The standard impeller is of the open type, made of hard cast iron and carefully ground so that it fits the casing closely and is in perfect balance.

SHAFT: The shaft is made of steel, key seated for impeller and pulley. A collar is fitted to the outer end for holding impeller central, and resisting any thrust action.

BEARINGS: The inboard bearing is a babbitt lined sleeve with grease cup lubrication, while the outer or pedestal bearing is a babbitt lined shell with ring oil lubrication. All bearing shells are removable and can be replaced at small cost. On the 1" pump there is a slight change in the bearing construction. The bearings for this size are bronze sleeves with grease cup lubrication.

STUFFING BOX: This box forms a part of the supporting head and is deep enough to serve its purpose without putting excess pressure on the packing. The glands are of cast iron, thoroughly machined and provided with heavy adjusting bolts.

BELT PULLEY: The pulley is of cast iron, with machined face, balanced, and fitted with key and set screws. The sizes listed are standard and cannot be changed without charge.

BED PLATE: The bed plate is of cast iron, with pads planed and drilled to receive the supporting head and pedestal bearing. Lugs for foundation bolts are provided.

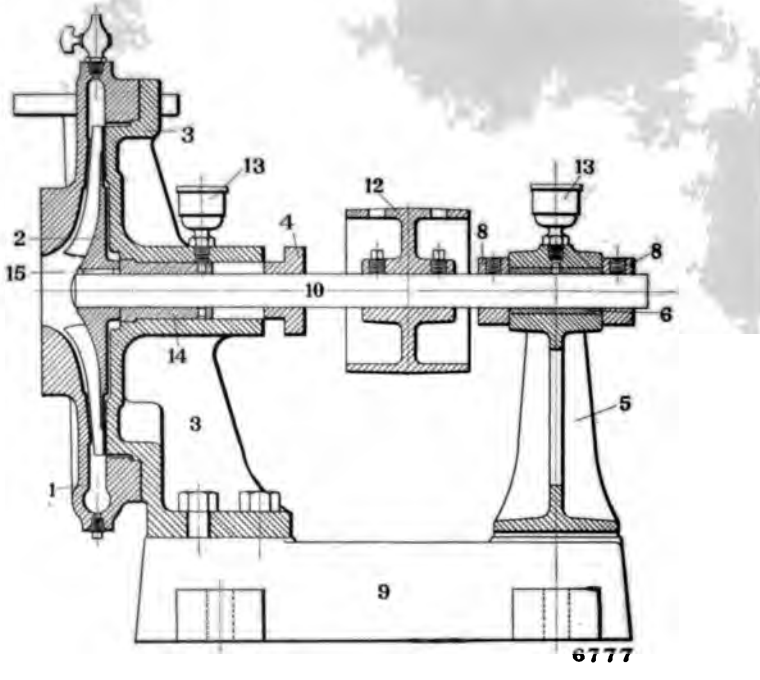
FLANGES: Companion flanges are furnished on pumps from 1" to 5" sizes inclusive.

PAINTING: All pumps are given one coat of steel color paint before shipment.

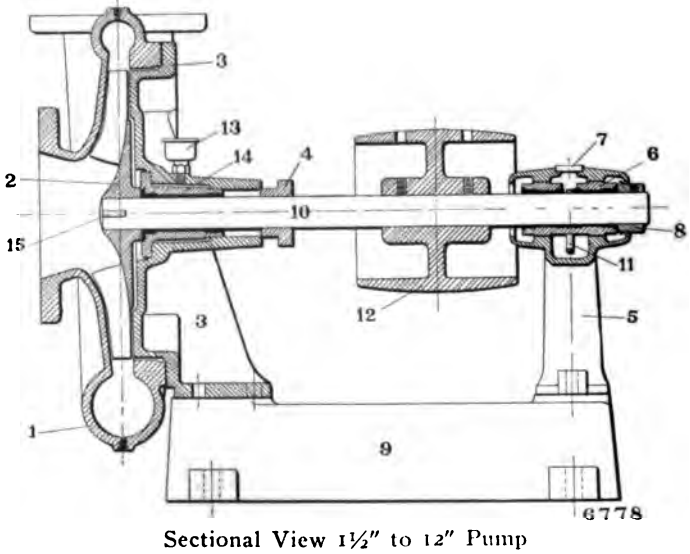
GENERAL: Material and workmanship of the highest grade are embodied in these pumps. Heads, capacities and powers stated are based upon accurate tests of different size pumps. All casings are tested by pressure to guard against weakness or leaks. The finish given to casings and impellers insure uniform working of all pumps.

LIST OF PARTS

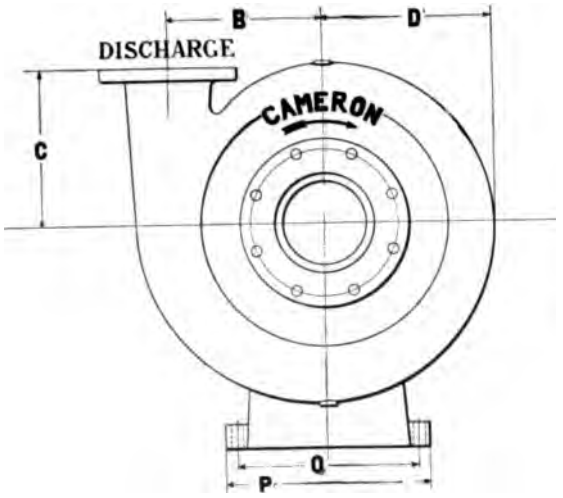
1. Casing.
2. Impeller.
3. Supporting Head.
4. Gland.
5. Pedestal Bearing.
6. Pedestal Bearing Bushing.
7. Oil Cup Cover.
8. Thrust Collar.
9. Bed Plate.
10. Shaft.
11. Oil Ring.
12. Pulley.
13. Grease Cup.
14. Inboard Bearing Sleeve.
15. Key.

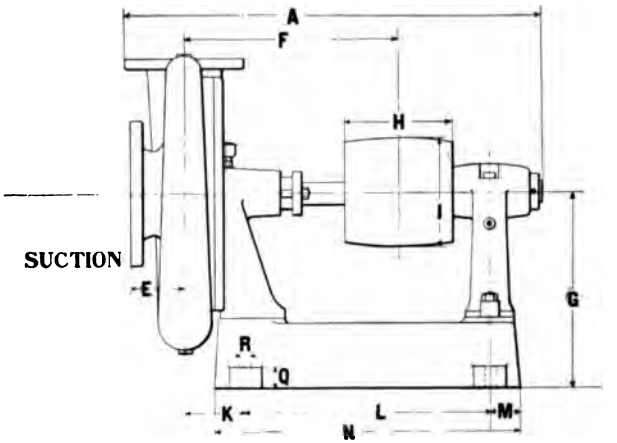


Sectional View 1" Pump



Sectional View 1½" to 12" Pump





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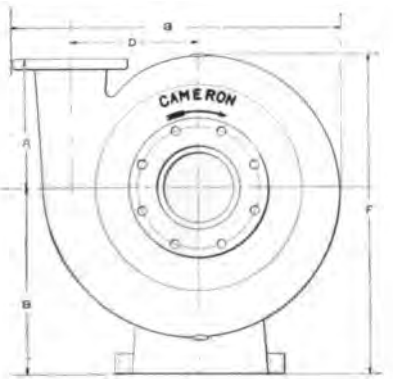
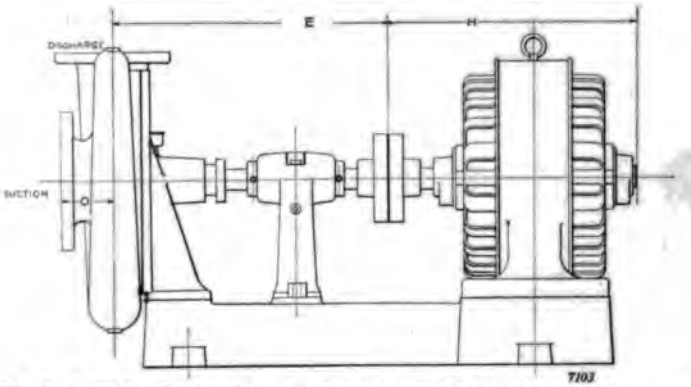
CAMERON SINGLE SUCTION BELTED CENTRIFUGAL PUMP—TABLE OF DIMENSIONS.

Size Pump	DISCHARGE					SUCTION					A	B	C	D	E	F	G	PULLEY		K	L	M	N	O	P	Q	R
	Dia.	Dia. Flange	Dia. Bolt Circle	Size Bolts	No. Bolts	Dia.	Dia. Flange	Dia. Bolt Circle	Size Bolts	No Bolts								H	I								
1	1	4	3	7/16	4	1 1/2	5	3 7/8	1/2	4	15 1/4	5 1/4	4 3/4	5 5/16	1 3/8	7 1/2	8 1/2	3	4	2 7/8	8 5/16	1 5/16	12 1/8	9 1/4	10 1/2	1 1/4	5/8
1 1/2	1 1/2	5	3 7/8	1/2	4	2	6	4 3/4	5/8	4	22 1/8	5 7/8	6 3/4	6	3/8	2 3/4	11 1/4	9 3/4	4	4	3 1/2	12 1/2	2 1/16	16 7/8	9 7/8	11 1/2	1	3/4
2	2	6	4 3/4	5/8	4	2 1/2	7	5 1/2	5/8	4	25 1/2	7 3/8	7 3/8	8	3 1/4	12 5/8	11 7/8	6	6	4 1/4	14 7/16	2 5/16	19 1/2	13 1/4	14 5/8	1 1/4	3/4
2 1/2	2 1/2	7	5 1/2	5/8	4	3	7 1/2	6	5/8	4	26	7 9/16	8	8	3 1/2	12 3/4	11 7/8	6	6	4 1/4	14 7/16	2 5/16	19 1/2	13 1/8	14 5/8	1 1/8	3/4
3	3	7 1/2	6	5/8	4	4	9	7 1/2	3/4	4	32 5/8	9 5/8	9 1/4	10	4 1/2	15 3/4	13 3/4	8	8	5 1/4	18 1/2	2 5/8	24	13	14 1/2	1 1/2	3/4
4	4	9	7 1/2	3/4	4	5	10	8 1/2	3/4	8	32 3/4	10	10 1/4	11	4 1/2	16 1/8	13 3/4	8	8	5 1/4	18 1/2	2 5/8	24	13	14 1/2	1 1/2	3/4
5	5	10	8 1/2	3/4	8	6	11	9 1/2	3/4	8	37 3/4	11 7/8	11 3/4	13	1 4 1/2	19 1/2	18	10	10	5 1/2	22 5/8	2 11/16	28 1/4	14 5/8	16 1/4	2	1
6	6	11	9 1/2	3/4	8	8	13 1/2	11 3/4	3/4	8	38 1/2	12 1/4	12 1/2	13 3/4	5	19 3/4	18	10	10	5 1/2	22 5/8	2 11/16	28 1/4	14 5/8	16 1/4	2	1
8	8	13 1/2	11 3/4	3/4	8	10	16	14 1/4	7/8	12	44 1/2	15	14 1/2	17	6 1/2	22 1/8	22	12	14	7 1/2	24	3 1/16	31 3/8	20 1/2	22 3/8	2	1 1/8
10	10	16	14 1/4	7/8	12	12	19	17	7/8	12	48 3/4	17 1/4	17 1/4	20 1/4	7 1/2	24 1/4	26	14	16	8 5/8	26 1/4	3 1/16	34 1/8	23 3/8	26	2	1 1/8
12	12	19	17	7/8	12	15	22 1/4	20	1	16	54 1/2	20 1/2	19 1/2	23 1/4	7 1/2	26 7/8	30	16	20	10 5/8	28 1/4	4 7/8	38	29 1/4	31 3/4	2 1/2	1 1/4

All dimensions in inches.





SINGLE SUCTION VOLUTE PUMP MOTOR DRIVEN—TABLE OF DIMENSIONS.

Size	DISCHARGE					SUCTION					A	B	C	D	E	F	G	H
	Dia.	Dia. Flange	Dia. Bolt Circles	Size Bolts	Bolts No. of	Dia.	Dia. Flange	Dia. Bolt Circle	Size Bolts	No. of Bolts								
1	1	4	3	7/16	4	1½	5	3⅞	⅝	4	4¾	8½	1⅜	5 ⅛	11¼	13½	7¾	18½
1½	1½	5	3⅞	⅝	4	2	6	4⅝	⅝	4	6⅝	9¾	2⅜	5 ⅞	16¼	16½	14⅜	19½
2	2	6	4¾	⅝	4	2½	7	5½	⅝	4	7⅜	12	3¼	7 ⅜	19	19¾	18⅜	2-1⅜
2½	2½	7	5½	⅝	4	3	7½	6	⅝	4	8	13¼	3½	7 7/16	19	21½	19½	2-5
3	3	7½	6	⅝	4	4	9	7½	¾	4	9¼	15½	4⅜	9 ⅜	23	2-1½	23⅞	2-7
4	4	9	7½	¾	4	5	10	8½	¾	8	10¼	15½	4⅜	10	23	2-2	2-1⅜	2-10
5	5	10	8½	¾	8	6	11	9½	¾	8	11¾	21½	4⅜	11 ⅞	2-3	2-10	2-6½	3-4
6	6	11	9½	¾	8	8	13½	11¾	¾	8	12½	21½	5	12 ¼	2-3	2-10½	2-7½	3-9
8	8	13½	11¾	¾	8	10	16	14¼	⅞	12	14½	20½	6½	15	2-7	3-½	3-2¾	4-7
10	10	16	14¼	⅞	12	12	19	17	⅞	12	17¼	2-3	7¼	17 ½	2-10	3-10	3-9½	5-3
12	12	19	17	⅞	12	15	22¼	20	1	16	19½	2-7	7½	20 ½	3-0	4-4¾	5-3¼	5-8

Dimensions in feet and inches.

DIRECTIONS FOR INSTALLING AND OPERATING

All pumps not submerged must be primed to start, to avoid injuring the interior parts that require water for lubrication.

Centrifugal Pumps do not need heavy foundations, but they must be strong enough to support the pumps firmly, and to avoid vibration due to possible shocks. Foundation bolts should not be set rigidly until the pump is placed in position.

The pump may then be aligned, the correctness of which may be determined by placing a level along the coupling flanges of pump and motor shaft. It will then be ready for grouting. After the grouting is set the foundation bolts may be tightened.

Suction and discharge piping must be self-supporting, and care should be taken not to strain the pump casing when connecting it to the pump.

It is advisable to make suction and discharge piping one or two sizes larger and connect same to the pump by means of increasers. There is a decided advantage in doing this, for it effects a saving in power and provides for a gain in pressure and an increased suction lift, if necessary. In laying the suction pipe line care should be taken also to avoid the formation of air pockets. If such are unavoidable the highest points must be evacuated at all times. A suitable check valve should be put on the discharge line close to the pump.

Before starting the pump the bearings and stuffing boxes should be examined and cleaned. Use only soft graphite packing in the stuffing boxes and do not pack too tight. Let a small amount of water seep through the boxes to avoid burning the packing. The necessary water supply can be regulated by the valves placed in water seal piping. This water serves also to seal the stuffing box and prevents air leaking through it.

The impeller of a Centrifugal Pump running in air cannot create sufficient vacuum to be self-priming. Therefore, all pumps not submerged must be primed to start. The priming can be effected by closing the discharge gate valve and exhausting the air by means of an ejector, or if suction pipe is fitted with a foot valve it may be filled with water from some suitable source and the air allowed to escape through an air cock on top of casing.

When the pump is fully primed it is ready to be started, in which case the pump should be brought up to its proper speed, and the discharge valve opened. After this the pump will need very little attention except an occasional inspection of the bearings, in which oil should be renewed from time to time. It is best to use a good quality of dynamo oil for lubricating the bearings.

The presence of air or gases in the suction line will considerably decrease the capacity and pressure. Care should be taken to avoid its entering the suction line by proper baffling or some other approved method.

When pumping any liquids having corrosive action on metals, the pump will be made of a special metal, but it will be necessary in such cases to occasionally inspect the interior of the pump and its working parts.

TABLE OF CAPACITIES, SPEEDS AND HORSE POWERS FOR SINGLE SUCTION OPEN IMPELLER VOLUTE PUMPS

Head in Feet	10			15			20			25			30		
Size	G.P.M.	H.P.	R.P.M.	G.P.M.	H.P.	R.P.M.	G.P.M.	H.P.	R.P.M.	G.P.M.	H.P.	R.P.M.	G.P.M.	H.P.	R.P.M.
1 "	23	.3	835	28	.5	1010	32	.7	1200	36	.9	1330	40	1.1	1450
	35	.4	975	40	.7	1150	46	1.0	1340	52	1.3	1460	57	1.60	1625
1½"	30	.30	610	38	.5	750	45	.8	865	50	.99	960	55	1.15	1050
	47	.50	680	58	.8	830	67	1.5	960	75	1.64	1070	82	2.10	1170
2 "	50	.5	480	62	.7	590	70	1.0	680	80	1.5	760	88	1.8	830
	80	.8	550	95	1.0	670	110	2.0	775	125	2.0	870	138	3.00	950
2½"	86	.7	480	106	1.2	586	120	1.6	680	135	2.08	760	150	2.70	830
	120	1.0	530	150	1.9	640	175	2.5	740	195	3.10	830	215	4.0	910
3 "	126	.66	390	155	1.6	485	180	2.3	560	200	3.0	625	220	3.8	685
	220	1.5	442	270	3.0	540	310	4.0	620	350	5.5	700	383	7.0	765
4 "	230	1.0	375	280	2.0	450	320	3.0	520	360	4.5	580	400	6.0	650
	350	2.0	425	420	3.0	515	490	5.0	590	540	7.0	665	600	8.5	730
5 "	330	1.7	350	410	3.0	430	470	4.5	495	525	6.0	555	580	8.0	605
	475	2.5	386	580	4.5	470	670	6.	545	750	9.0	610	820	11.5	670
6 "	490	2.5	350	600	4.0	430	690	6.0	495	775	8.2	555	850	10.5	605
	790	4.0	410	970	7.0	505	1120	10.0	580	1250	13.8	650	1370	17.5	715
8 "	900	4.5	305	1100	7.5	375	1275	11.5	430	1400	14.0	480	1525	19.0	510
	1225	6.0	340	1500	11.0	415	1725	15.8	480	1925	21.0	535	2100	26.0	585
10 "	1300	6.5	250	1585	11.0	310	1830	16.0	350	2050	21.5	390	2240	27.5	428
	1900	9.5	270	2320	17.0	330	2680	23.5	383	3000	32.0	430	3290	41.0	470
12 "	1930	9.5	215	2360	16.5	263	2730	24.0	303	3050	32.0	340	3340	41.0	370
	3000	15.0	244	3680	27.0	300	4250	38.5	347	4750	51.0	386	5200	65.0	424

Head in Feet	35			40			50			60			70		
Size	G.P.M	H.P.	R.P.M.	G.P. M	H.P.	R.P.M.	G.P.M.	H.P.	R.P.M	G.P.M.	H.P	R.P.M	G.P.M.	H.P.	R.P.M.
1 "	43	1.30	1600	45	1.5	1710	50	2.0	1900	55	3.0	2050	61	3.5	2200
	63	2.0	1800	68	2.30	1900	75	3.00	2100	80	4.0	2300	92	5.5	2500
1½"	60	1.58	1140	65	1.97	1250	70	2.5	1350	80	3.38	1540	84	4.2	1620
	90	2.65	1285	95	3.20	1350	105	4.3	1500	115	5.45	1650	125	7.0	1800
2 "	95	2.2	900	105	2.5	970	115	3.6	1075	125	4.5	1180	134	5.7	1275
	150	4.	1030	160	4.5	1100	180	6.4	1230	195	8.0	1350	210	10.0	1450
2½"	160	3.3	895	175	3.93	960	195	5.3	1070	210	6.6	1170	228	8.5	1275
	230	4.9	980	250	5.93	1045	275	8.1	1170	300	10.3	1280	326	13.0	1385
3 "	240	4.6	740	265	5.70	790	285	7.2	885	310	8.85	970	335	11.0	1045
	415	9.0	825	445	10.0	885	495	13.0	990	542	16.5	1090	585	20.5	1170
4 "	425	6.5	695	455	8.0	710	510	11.0	830	560	14.5	920	620	18.5	1000
	650	11.0	790	700	13.0	840	775	17.5	950	850	23.0	1040	920	28.5	1070
5 "	620	9.5	650	670	11.5	700	750	15.5	785	820	20.0	860	880	25.0	930
	890	14.0	720	950	16.8	770	1060	23.0	860	1160	32.5	945	1250	37.2	1020
6 "	915	13.0	655	980	15.5	700	1095	22.0	785	1200	28.5	860	1300	36.0	930
	1475	21.5	770	1580	30.5	825	1770	36.0	920	1930	47.5	1010	2090	60.0	1090
8 "	1650	23.5	540	1770	28.5	570	1975	38.2	640	2150	50.5	750	2340	63.0	755
	2280	32.5	635	2425	39.0	680	2725	52.5	760	2975	69.0	830	3220	81.5	830
10 "	2420	33.5	460	2590	39.5	495	2900	54.9	552	3170	71.0	604	3430	89.0	655
	3540	49.5	507	3790	58.5	540	4240	81.5	607	4650	107.	665	5000	113.0	715
12 "	3610	48.5	400	3850	59.0	428	4310	80.0	480	4710	102.	525	5100	128.	570
	5600	78.0	443	6000	93.5	488	6700	130.0	545	7350	168.	600	7950	213.	645

Cameron Centrifugal Pumps

FOR HOUSE SERVICE

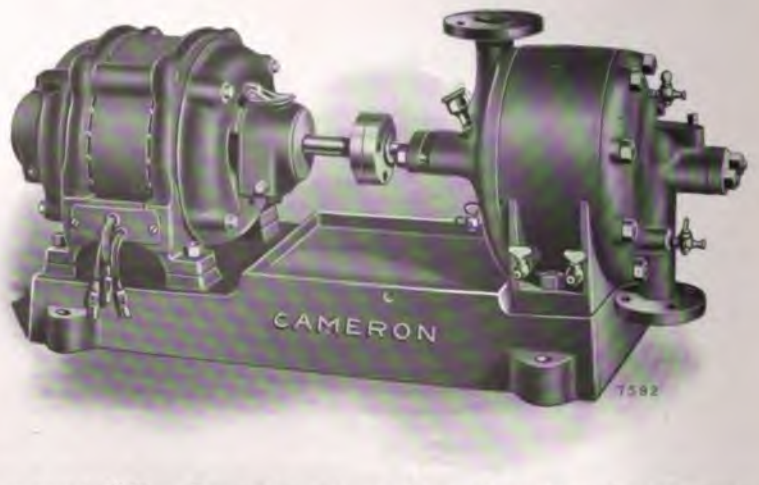
A. S. CAMERON STEAM PUMP WORKS
11 Broadway, New York

Bulletin No. 153 May, 1914

Cameron Two-Stage House Pump, direct-connected to electric motor.

CAMERON HOUSE PUMPS

Cameron 1¼" Two-Stage House Pump—Belt Driven.



Cameron 1¼" Four-Stage House Pump, direct-connected to electric motor.

The Slogan of the Cameron—

CHARACTER: "THE GRANDEST THING"

CAMERON HOUSE PUMPS

CAMERON CENTRIFUGAL HOUSE PUMPS have been designed especially to supply small volumes of water, or to increase the water pressure, in office buildings, apartment houses, hotels, hospitals, country residences and factories. They may also be used for supplying water to gardens and parks, or as circulating pumps in connection with fountains, natatoriums, heating systems, etc.

The features of these pumps that recommend them for this service are simplicity of design, compact construction and absolute safety in operation. They produce a constant supply of water, require little attention, and the cost for upkeep and repairs is very low.

These pumps are available in four sizes, 1", 1¼", 1½" and 2", suitable for various capacities and pressures. They may be driven by electric motor, or by belt with naphtha, gas or gasoline engine, to suit local conditions.

Our Engineering Department will be glad to figure on your pumping problem. Kindly state all the conditions of service on the data sheet, page 5, send it to us, and we will give the matter our prompt attention.

TABLE OF HEADS AND CAPACITIES

1" SINGLE STG. PUMP with ¾ h. p. 110 or 220 volt — D. C. motor 2500 R. P. M.	Head	25	30	35	40	45	—
	Gals. per hr.	2400	2100	1800	1500	900	—
1" SINGLE STG. PUMP with ¾ h. p. 60 cycle single phase 110 or 220 volt — A. C. motor 3250 R. P. M.	Head	25	30	35	40	45	50
	Gals. per hr.	2400	2100	1850	1600	1200	700
1¼" 2 STAGE PUMP with 1 h. p. 110 or 220 volt — D. C. motor 2600 R. P. M.	Head	60	70	80	90	100	110
	Gals. per hr.	1950	1800	1500	1200	900	—
1¼" 2 STAGE PUMP with 1½ h. p. 60 cycle single phase 110 or 220 volt — A. C. motor 3250 R. P. M.	Head	60	70	80	90	100	—
	Gals. per hr.	2150	1900	1650	1300	750	—

NOTE—The above pumps, equipped complete, as described, are carried in stock.

Cameron 1″ Single-Stage House Pump—Belt Driven.

Cameron 1″ Single-Stage House Pump, direct-connected to electric motor.

DATA REQUIRED FOR ESTIMATES

Kindly answer the following questions as fully as possible:

1. Number of pumps required_____
2. Capacity of each pump_____gallons per minute.
3. Total lift, including discharge, suction and pipe friction_____feet.
4. Suction lift and distance from supply_____
5. Variation in lift, both discharge and suction, if any_____
6. Quality of liquid—fresh water, gritty, acidulous, solids in suspension?_____
7. Temperature of liquid_____°Fahr. Specific gravity_____
8. Service continuous_____Intermittent_____

MOTIVE POWER

9. Direct-connected to motor. Direct current, voltage_____
   Alternating current, voltage_____Cycles_____Phase
10. Belted—Give speed of motive power_____
11. Motive power furnished by purchaser_____By builder_____
12. Remarks_____

(Complete this sheet, detach and forward it with your inquiry)

DATA REQUIRED FOR ESTIMATES

Kindly answer the following questions as fully as possible:

1. Number of pumps required.....

2. Capacity of each pump.....gallons per minute.

3. Total lift, including discharge, suction and pipe friction.....feet.

4. Suction lift and distance from supply.....

5. Variation in lift, both discharge and suction, if any.....

6. Quality of liquid—fresh water, gritty, acidulous, solids in suspension?.....

7. Temperature of liquid.....°Fahr. Specific gravity.....

8. Service continuous.....Intermittent.....

MOTIVE POWER

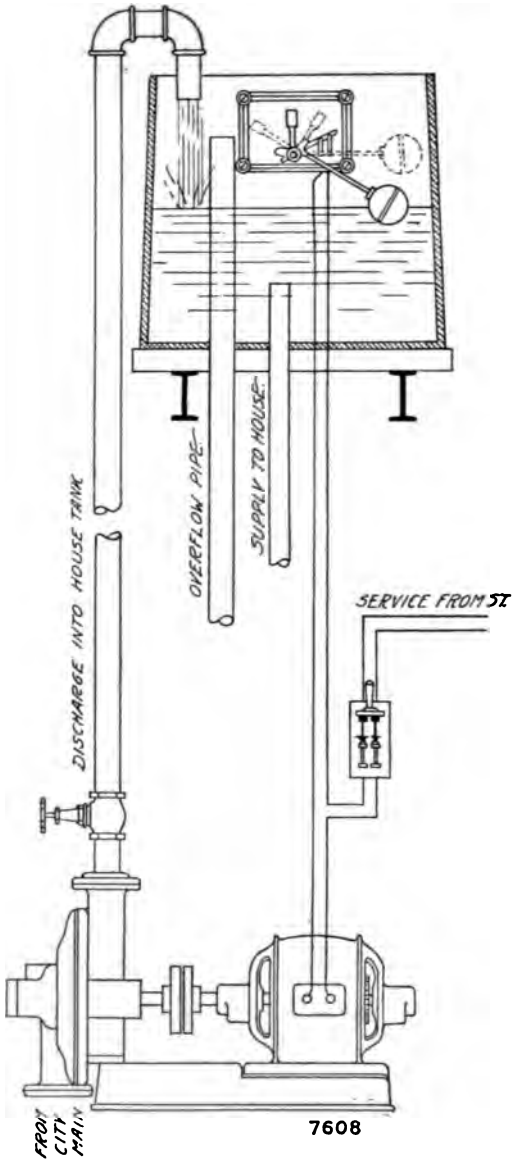
9. Direct-connected to motor. Direct current, voltage.....

   Alternating current, voltage.....Cycles.....Phase

10. Belted—Give speed of motive power.....

11. Motive power furnished by purchaser.....By builder.....

12. Remarks.....



Cameron Two-Stage House Pump with elevated tank and automatic control system.

AUTOMATIC CONTROL SYSTEM

When these pumps are direct-connected to electric motor, two systems of automatic control may be used, the open or elevated tank system and the closed or pneumatic control system.

With the open or elevated tank system, the operation of the pump is controlled by means of a float switch, which is set to start and stop the pump at the minimum and maximum water levels. By means of this switch, the pump will start when the low level in the tank is reached and stop at maximum water level.

With the closed or pneumatic control system, the water is pumped into a closed wrought iron tank, and as the water rises, the air contained therein is being compressed to, say, forty pounds. When this pressure is reached, the pressure regulator attached to the tank brings the pump to a stop by shutting off the current. Should the water be drawn off at any point, the compressed air will expand and force the water through the faucet or other opening until the pressure in the tank drops to, say, fifteen pounds, when the pump will automatically start and continue operating as long as the water is being drawn and until the pressure of 40 pounds is restored.

By either of these methods of automatic control, no electricity is consumed unless water is actually being pumped, thereby insuring maximum efficiency and economy.

The intermittent operation depends entirely on the size of the tank; the larger the tank the more water can be drawn without re-starting the pump.

The pump should be located in a place where it is protected against frost. The dynamic suction lift should not exceed fifteen to eighteen feet, and a foot valve with suitable strainer should be attached to the end of the suction pipe. However, no foot valve will be required in the suction line if the water comes to the pump under a head, as will be the case when the supply is taken from a pressure main. It is advisable to place a throttle valve (gate or globe) in the discharge line near the pump so that the head and capacity may be conveniently regulated.

As a centrifugal pump running at a certain speed can only create a certain maximum pressure, it is impossible to burst the pipe line, even if through carelessness the valve in the discharge pipe is closed.

A. S. CAMERON STEAM PUMP WORKS

11 Broadway, New York, U. S. A.

OFFICES IN THE UNITED STATES

BIRMINGHAM, ALA.	American Trust Building
BOSTON, MASS.	32 Oliver Street
CHICAGO, ILL.	People's Gas Building
CLEVELAND, OHIO	Williamson Building
DENVER, COL.	17th Street, corner Wynkoop
DULUTH, MINN.	Providence Building
EL PASO, TEXAS	121 San Francisco Street
HOUGHTON, MICH.	Citizens' National Bank Building
JUNEAU, ALASKA.	
KNOXVILLE, TENN.	Holston National Bank Building
LOS ANGELES, CAL.	1036 Union Oil Building
PHILADELPHIA, PA.	Commercial Trust Building
PITTSBURGH, PA.	Farmers' Bank Building
ST. LOUIS, MO.	300 N. Broadway
SALT LAKE CITY, UTAH	224 S. W. Temple Street
SAN FRANCISCO, CAL.	139 Townsend Street
SEATTLE, WASH.	Colman Building
WASHINGTON, D. C.	Home Life Building

FOREIGN OFFICES

BUDAPEST, AUSTRIA-HUNGARY, m.b.h	IV Ferenz Jozef Rakpart 17
COBALT, ONTARIO	Silver Street
DUSSELDORF, GERMANY	Concordia-Haus, Oststrasse 128-132
SYDNEY, N. S.	60 Prince Street
JOHANNESBURG, SOUTH AFRICA	Exploration Buildings
KALGOORLIE, WEST AUSTRALIA	90 Egan Street
LONDON, ENGLAND	165 Queen Victoria Street, E. C.
MELBOURNE, AUSTRALIA	41 Queen Street
MEXICO CITY, MEX.	Cadena No. 2
MONTREAL, QUEBEC	Commercial Union Building
PARIS, FRANCE	33 Rue Reaumur
ROSSLAND, B. C.	
TORONTO, ONTARIO	1105 Traders' Bank Building
VANCOUVER, B. C.	709 Dominion Building
WINNIPEG, MANITOBA	817 Union Bank Building

BULLETIN No. 102

REG. U.S. PAT. OFF.

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Cameron Pumps

Manufactured by

A. S. CAMERON STEAM PUMP WORKS

11 Broadway

New York, U. S. A.

CODES USED: ATLANTIC, WESTERN UNION, LIEBER'S A. B. C.
5th EDITION, INGERSOLL-RAND, MOREING & NEAL
AND MARCONI'S WIRELESS
CABLE ADDRESS, "NOREMAC" NEW YORK

The CAMERON policy, steadily pursued ever since the inception of the business, has been to build the very best pump that the best of material and most skilful workmanship can produce. We hold that time has demonstrated the wisdom of refusing to sacrifice, on the score of cheapness, the high quality of workmanship and material, but more especially the excellence of design, which renders the CAMERON durable beyond all others, and its few working parts readily and easily replaceable. Moreover, we believe in buying a CAMERON you will save money in cost of repairs.

Besides other sterling qualities, the three points of excellence peculiar to the CAMERON are: First, Simplicity; second, Durability; third, Entire absence of outside valve gear or moving parts.

SIMPLICITY

The CAMERON pump has fewer working parts than any other steam pump made.

DURABILITY

The steam mechanism consists of four stout pieces only, none of them delicate, intricate or exposed to injury. The operation of this mechanism is such that—

While under full pressure of steam, the suction pipe may be lifted out of the water and the pump allowed to run away or race as fast as steam will drive it, with less danger of the piston striking the heads or doing any injury to the pump than any other pump on the market. The advantage of this can scarcely be exaggerated, since under most conditions any pump is liable to have its supply of water cut off unexpectedly. Furthermore, the CAMERON is made stronger and heavier than other pumps of the same capacity.

ABSENCE OF OUTSIDE VALVE GEAR

The steam valve movement works in line with the main piston without the aid of arms or levers. Therefore, the CAMERON pump can be run faster, with less danger of breaking, than any pump employing an outside valve movement. It has no rods to become bent, broken or get out of alignment, no tappet bars, rollers or clamps to be adjusted.

The CAMERON pump has no dead center, and will always start at any point of the stroke; it can be run so slowly that the eye can hardly detect the motion of the piston rod.

This pump can be completely taken apart without disconnecting any of the piping.

The cylinders are made of hard, close-grained iron, and thick enough to permit reboring. All CAMERON pumps, unless otherwise ordered, are fitted with valve seats of best composition metal, and arranged to handle fresh, cold water. If required to handle feed water of high temperature, they will be supplied with the proper valves and packing.

There are on the market many other pumps with inside steam mechanism and valve gear. Examination will show that they lack the simplicity claimed for them. Some of these pumps, sold for boiler feeding, are equipped with deflecting valves for turning their exhaust steam into the suction. The oil or any lubricant from the cylinder thus carried in with the feed water is highly injurious to the boiler, and the practice is severely condemned by boiler insurance inspectors. On the other hand, the Steam mechanism of CAMERON pumps has no minute steam ports, grooves, packing rings or other complicated devices, and the pumps themselves are especially noted for their ability to perform exacting service and work under trying conditions. They can stand almost any amount of rough usage, and we know they often do stand a great deal of abuse.

Every pump sold by us is thoroughly tested before leaving the works, and the record filed for future reference. It is fully guaranteed to be exempt from any faulty construction and from defects of material or workmanship. Its satisfactory operation is also guaranteed on condition that it is properly set up, reasonably cared for, and used for a service and capacity corresponding to its proportions and design.

Many inaccurate statements and unwarranted claims have been advanced in behalf of duplex pumps. Several makers go as far as to state that their duplex pumps are "double the capacity of single pumps of the same diameter and stroke," a misrepresentation which we can hardly let pass unnoticed. In the first place a CAMERON pump can be run safely and comfortably

at a speed that would quickly wreck a duplex pump with its lever arm contrivances. But even at a low speed duplex pumps seldom attain even their theoretical capacities, and the reason for this is neither mysterious nor difficult to understand. In all duplex pumps each steam piston is controlled and reversed by a connection with the opposite piston rod. Since it is beyond human ingenuity to pack two machines so that friction will be equal, it follows that one piston must move more sluggishly than the other, and this piston is constantly interrupted and reversed before it has a chance to complete its stroke. One pump is constantly short stroking.

A CAMERON pump cannot reverse until it has completed its full, honest stroke.

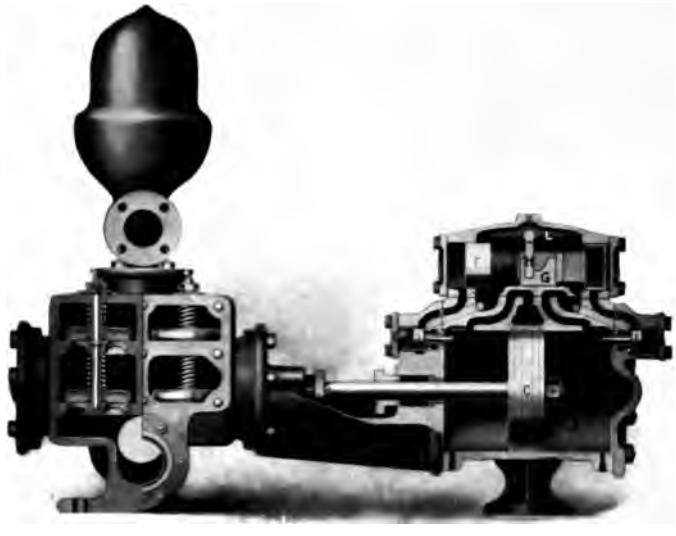
A CAMERON pump can be run continuously and without detriment at greater speed than any duplex pump made.

For two reasons most duplex pumps are very extravagant in the use of steam. First, because of the wasted clearance of steam in the cylinder when the piston is not traveling its full stroke. Second, because duplex pumps have double the number of ports, and steam spent in filling ports is steam wasted.

A duplex pump has more than double the number of parts to keep in repair, and when any one gives out the whole machine is crippled.

In nearly all duplex plunger pumps cheaply built for boiler feeding and other purposes, there is no possible way of compensating for wear—the more the water plunger wears the more churning and less pumping is done. Of course, the "parts can be renewed"—the oftener, the more there is in it for the maker.

Every CAMERON pump is packed to compensate for wear.



All single, direct-acting pumps make use of an auxiliary plunger to carry the main slide valve, which gives steam to the main piston. By means of various devices steam pressure is made to drive this auxiliary plunger backward and forward. In the CAMERON pump the plunger is reversed by means of two plain tappet valves, and the entire mechanism thus consists of four stout pieces only, all working in direct line with the main piston. Simple and without delicate parts, it is the only inside valve gear that is absolutely reliable.

EXPLANATION

A is the steam cylinder; *C*, the piston; *L*, the steam chest; *F*, the chest plunger, the right-hand end of which is shown in section; *G*, the slide valve; *H*, a lever, by means of which the steam chest plunger *F* may be reversed by hand when expedient; *II*, are reversing valves; *KK* are the reversing valve chamber bonnets, and *EE* are exhaust ports leading from the ends of steam chest direct to the main exhaust and closed by the reversing valves *II*.

OPERATION

C, the piston, is driven by steam admitted under the slide valve *G*, which, as it is shifted backward and forward alternately connects opposite ends of the cylinder *A* with the live steam pipe and exhaust. This slide valve *G* is shifted by the auxiliary plunger *F*; *F* is hollow at the ends, which are filled with steam, and this, issuing through a hole in each end, fills the spaces between it and the heads of the steam chest in which it works. Pressure being equal at each end, this plunger *F*, under ordinary conditions, is balanced and motionless; but when the main piston *C* has traveled far enough to strike and open the reverse valve *I*, the steam exhausts through the port *E* from behind that end of the plunger *F*, which immediately shifts accordingly and carries with it the slide valve *G*, thus reversing the pump. No matter how fast the piston may be traveling, it must instantly reverse on touching the valve *I*. In its movement the plunger *F* acts as a slide valve to close the port *E*, and is cushioned on the confined steam between the ports and steam chest cover. The reverse valves *II* are closed as soon as the piston *C* leaves them by a constant pressure of steam behind them conveyed direct from steam chest through the ports shown by dotted lines.

The illustration on the preceding page shows the CAMERON valve chest and arrangement of water valves. The superiority of this valve chest lies in its accessibility. By simply removing one bonnet or cover, the whole interior with every valve is plainly visible, turned inside out, so to speak, and not a speck of anything that may have lodged there can escape detection. The shelves or decks are bored out tapering, and the brass seats forced in. They can thus be readily taken out and renewed at any time. Each stem holds two valves, with their springs one above the other, so that by simply unscrewing one plug, and pulling up the stem, both are released. It will be noticed that the CAMERON valve chest is placed close to the ground and beside the water piston, instead of above it as in other makes. The valves are therefore just so much nearer the water, and the suction lift is reduced accordingly. Every pump has two suction openings, one on each side, and the discharge opening can be turned in any direction desired.

DIRECTIONS FOR ORDERING

In order that we may be able to answer your inquiry intelligently, and to save time, please inform us as far as possible upon the following points:

What is the liquid to be pumped?

If water, is it hot or cold? Is it pure, or does it contain salt, acid, sulphur, sand or grit?

What is the average quantity to be pumped per minute? What is the maximum that the pump might be called upon to handle?

How high is the liquid to be forced?

How far—that is, what is the length of discharge pipe?

If pipe is already laid, what is its diameter and how many turns does it make?

What is the steam pressure at the pump?

Will the pump exhaust into the atmosphere? If against back pressure, how much?

What is the height of suction lift—how far above water will the pump be placed? What is the total length of suction pipe? And how many elbows or turns?

DIRECTIONS FOR SETTING UP AND RUNNING PUMPS

Blow out steam pipe thoroughly before connecting up your pump. Any dirt or rubbish carried into a steam cylinder will cut and wear it away.

After pump is connected remove reverse valve covers or plugs, take out valves and blow steam through. Then carefully wipe valves and pockets clean before replacing the former.

Never use smaller pipe than size given in tables. Long pipes should be of even greater diameter to allow for increased friction. This applies particularly to suction pipe.

Run pipe as nearly in a direct line as you can. Turns and elbows greatly increase friction, and all bends should be as large and gradual as possible.

In cold weather, open the drip cocks to drain the steam and water cylinders, otherwise they may burst if allowed to freeze.

Suction pipe must be absolutely tight, and it is always well to use a foot valve and strainer.

Place your pump as near the water as possible. At sea level water will rise 33.9 feet in a perfect vacuum, but practically no steam pump can draw water to anything like such a height by suction. Hot water cannot well be lifted by suction, since its vapor destroys the necessary vacuum. Therefore, to pump hot water the supply should be placed above pump and delivered to it from a head.

A vacuum chamber upon the suction pipe, close to the pump, is always an advantage, and on long lines of pipe or on pumps running at high rate of speed is absolutely necessary. Its utility consists in causing a steady and uniform flow of the liquid through the suction pipe, and thus preventing "pounding" or water hammering, which (without one) is always incident to long suctions.

When working under very heavy duty put an air cock in the suction pipe between the vacuum chamber (should there be one) and the pump, and by admitting a small quantity of air keep the air chamber supplied. The surplus air, passing with the water into the discharge pipe, forms an elastic column, preventing water hammering and consequent shock on the pump and pipes.

Do not use tallow in the steam cylinder, but a little of the best refined mineral, sperm or lard oil. Any oil that corrodes or gums the working parts is unfit for use.

Regular Pattern Piston Pump

This type is designed for general service. It is made either with iron water cylinder unlined and steel piston rod, or fitted with water cylinder lining, piston and piston rod of composition, as desired. The above illustration shows sizes 5 to 10a. This pump is also made in larger sizes, which are the same as shown above except that they have more water valves.

Code Word*	Size Number	Price with Iron Water Cylinder and Steel Piston Rod	Price with Iron Water Cylinder, Composition Lining, Piston and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity at Ordinary Speed, per Minute, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Floor Space, Inches	Weight
Zaaby	0	$ 80	$ 85	3½	2	4	8	⅜	½	1¼	1	32x9	136
Zaadu	1	120	125	4	2	6	12	⅜	½	1¼	1	40x10	210
Zaaes	2	140	150	5	2½	6	18	½	¾	1½	1¼	40x11	254
Zaago	3	165	175	6	3	7	28	¾	1	2	1½	47x13	418
Zaahm	3a	185	200	6	3½	7	38	¾	1	2½	2	47x15	435
Zaaik	4	210	225	7	3½	7	38	¾	1	2½	2	47x15	459
Zaaji	4a	235	250	7	4	7	50	¾	1	2½	2	51x16	457
Zaalt	5	275	290	7	3½	12	50	1	1½	3	2½	58x17	820
Zaamz	5b	325	350	7	5	13	100	1	1½	4	3	63x20	1117
Zaanz	6	325	340	8	4	12	65	1	1½	3	2½	58x18	864
Zaaox	6a	350	375	8	5	13	100	1	1½	4	3	63x20	1160
Zaarp	7	375	400	10	5	13	100	1¼	2	4	3	64x21	1345
Zaasn	8	400	425	10	6	13	150	1¼	2	4	3½	64x21	1411
Zaatl	9	470	520	12	7	13	200	1½	2½	5	4	66x24	1928
Zaauj	10a	540	575	14	8	13	261	2	3	5	5	73x26	2548

* If pump with iron water cylinder and steel piston rod is desired, add the word "Zabil." If pump with iron water cylinder, composition lining, piston and piston rod is desired, add the word "Zablu."

Regular Boiler Feed Pattern

The main difficulty met with in fixing on the proper size of pump to recommend is that the horse-power of the boiler for which the pump is required, is about all the information furnished. The expression "horse-power," as applied to boilers, is a very indefinite term; what should be given, if possible, is the quantity of feed water required, and a pump which will supply this quantity at about one-half its rated capacity at ordinary speed will be right for cold water, and say, one-third speed for hot water.

In feeding hot water the pump should be placed below the source of supply.

Sizes 0 to 3b are made as illustrated on this page.

Code Word *	Size Number	Price with Iron Water Cylinder and Steel Piston Rod	Price with Iron Water Cylinder, Composition Lining, Piston and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Boilers, in Horse Power, they will supply at Moderate Speed Based on 30 lbs. of water per Horse Power per Hour	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Floor Space, Inches	Weight
Zabna	0	$80	$85	3½	2	4	40	⅜	½	1¼	1	32x9	136
Zaboy	1	120	125	4	2	6	60	⅜	½	1¼	1	40x10	210
Zabso	2	140	150	5	2½	6	90	½	¾	1½	1¼	40x11	260
Zabuk	2a	150	165	5	3	7	140	½	¾	2	1½	47x12	347
Zabvi	2b	160	170	5	3½	7	190	½	¾	2½	2	47x14	355
Zabxe	3b	210	225	6	4	7	250	¾	1	2½	2	47x14	444
Zabyc	3c	210	225	6	3½	12	325	¾	1	3	2½	58x17	508
Zacac	3d	230	245	6	4	12	425	¾	1	3	2½	58x17	525
Zacha	5a	280	310	7	4½	12	525	¾	1	3	2½	58x18	725
Zaccy	5b	325	350	7	5	13	670	1	1½	4	3	63x20	1117
Zaceu	..	390	415	9	6	13	1000	1	1½	4	3½	64x21	1202
Zacho	..	445	490	10	7	13	1325	1¼	2	5	4	66x24	1770
Zacim	..	500	530	12	8	13	1725	1½	2½	5	5	73x26	2010
Zacki		...	...	14	9	18	2200	2	3	6	5	81x30	3125

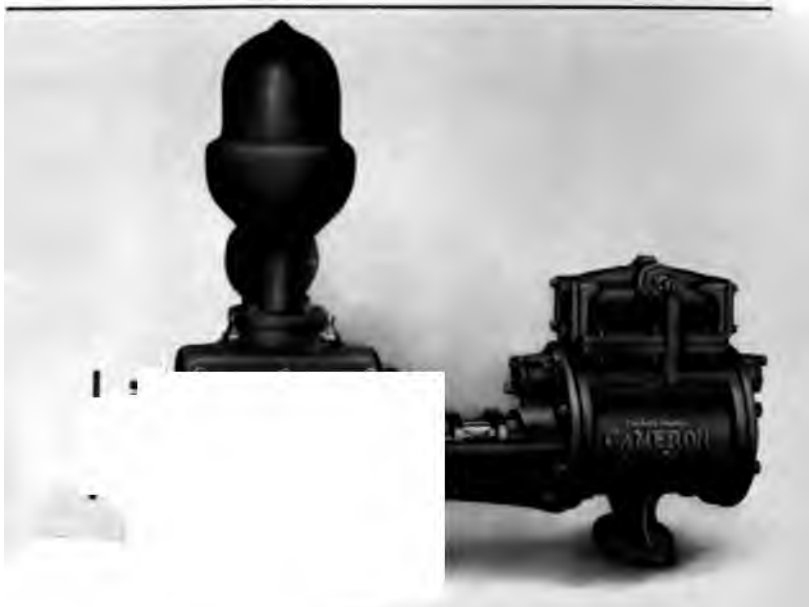
* If pump with iron water cylinder and steel piston rod is desired, add the word "Zabil." If pump with iron water cylinder, composition lining, piston and piston rod is desired, add the word "Zablu."

Long Stroke Piston Pump

This type is especially adapted for rolling mills, blast furnaces, sugar or oil refineries, and other situations where continuous pumping is required. Its piston stroke being nearly twice the length of that of the "regular" type, all working parts, except pistons and rod, are brought into action only half the number of times for the same piston speed; wear and tear is reduced and the life of the pump prolonged accordingly. Valve chests are placed at both ends of the water cylinder, thus making the water passages short and direct.

Code Word*	Size Number	Price with Iron Water Cylinder and Steel Piston Rod	Price with Iron Water Cylinder, Composition Lining, Piston and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity per Stroke, Gallons	Capacity at Ordinary Speed, per Minute, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Length over all, Inches	Height over all, Inches	Width over all, Inches	Weight
Zadoa	7	$450	$500	10	5	25	2.12	115	1¼	2	5	3½	87	45	22	1687
Zadpy	8	475	525	10	6	25	3.0	170	1¼	2	5	3½	87	45	22	1741
Zadto	9	550	600	12	7	25	4.17	225	1½	2½	6	4	90	57	24	2345
Zadum	10	....	....	14	9	33	9.08	350	2	3	8	6	118	70	30	4235
Zadwi	11	....	....	16	10½	33	12.37	500	2½	4	10	8	122	74	36	5732
Zadye	12	....	....	18	12	38	18 60	660	3	4	12	10	142	92	42	7830

* If pump with iron water cylinder and steel piston rod is desired, add the word "Zabil." If pump with iron water cylinder, composition lining, piston and piston rod is desired, add the word "Zablu."



Removable Bushing Pattern

Where mine water is very gritty and the use of a plunger pump is prohibited on account of limited space or other circumstances, to secure the greatest durability possible with a piston pump, we supply a removable bushing of iron or composition. This bushing can be turned in the pump so that the wear, which is usually greatest on the bottom, can be gradually distributed over every portion of its surface. Furthermore, if, from the deepening of the mine, it becomes necessary for the pump to be placed lower, the removable bushing can be replaced by one of smaller diameter, thus changing the proportions of the pump, and enabling it, within certain limits, to work against a greater head.

Code Word*	Size Number	Price, with Iron Bushing and Steel Piston Rod	Price, with Composition Bushing, Piston and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity per Stroke, in Gallons	Capacity at Ordinary Speed per Minute, in Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Zagmi	0	$85	$90	3½	2	4	.054	8	⅜	½	1¼	1	136
Zagod	1	130	135	4	2	6	.081	12	⅜	½	1¼	1	210
Zagsu	2	150	160	5	2½	6	.12	18	½	¾	1½	1¼	260
Zagts	3	175	185	6	3	7	.21	28	¾	1	2	1½	418
Zagup	3a	200	215	6	3½	7	.29	38	¾	1	2½	2	435
Zagyh	4	225	240	7	3½	7	.29	38	¾	1	2½	2	459
Zagzk	4a	250	265	7	4	7	.39	50	¾	1	2½	2	457
Zahah	5	290	305	7	3½	12	.5	50	1	1½	3	2½	820
Zahez	5b	350	375	7	5	13	1.10	100	1	1½	4	3	1117
Zahfy	6	340	355	8	4	12	.65	65	1	1½	3	2½	864
Zahhu	6a	375	400	8	5	13	1.10	100	1	1½	4	3	1160
Zahis	7	400	425	10	5	13	1.10	100	1¼	2	4	3	1345
Zahla	8	430	455	10	6	13	1.58	150	1¼	2	4	3½	1411
Zahow	9	500	550	12	7	13	2.16	200	1½	2½	5	4	1928
Zahtt	10a	575	610	14	8	13	2.83	261	2	3	5	5	2548

* If pump with iron bushing and steel piston rod is desired, add the word "Zabil." If pump with composition bushing, piston and piston rod is desired, add the word "Zablu."

Regular Light Service Pattern

This pump is adapted for filling tanks, irrigating and light duty generally, in factories, and for situations where a considerable quantity of water is to be lifted to a limited elevation. It is not proportioned for mining work, nor to force water against heavy lifts, as the steam cylinder is relatively smaller in diameter, but the water cylinder is strongly built and of the standard type. In light service, pressure on the valves being low, the pump can, therefore, be run faster; thus obtaining a somewhat greater capacity than given in the list.

Code Word*	Price with Iron Water Cylinder and Steel Piston Rod	Price with Iron Water Cylinder, Composition Lining, Piston and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Water Cylinder, Inches	Stroke of Piston, Inches	Capacity at Ordinary Speed per Minute, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Weight
Zaeew	$140	$150	4	3	7	28	⅜	½	2	1½	335
Zaegt	150	160	4	3½	7	38	⅜	½	2½	2	346
Zaehr	160	170	5	3½	7	38	½	¾	2½	2	358
Zaeio	160	170	4	4	7	50	⅜	½	2½	2	345
Zaejm	170	180	5	4	7	50	½	¾	2½	2	360
Zaekk	210	225	5	5	7	80	½	¾	3	2½	553
Zaemg	230	250	6	5	7	80	¾	1	3	2½	628
Zaend	275	300	6	6	7	115	¾	1	4	3	800
Zaeob	285	310	7	6	7	115	¾	1	4	3	824
Zaepz	380	435	7	7	13	200	1	1½	5	4	1540
Zaeru	400	450	8	7	13	200	1	1½	5	4	1575
Zaess	425	465	9	7	13	200	1	1½	5	4	1680
Zaeun	445	490	10	7	13	200	1¼	2	5	4	1800
Zaewj	410	450	7	8	13	261	1	1½	5	5	1630
Zaexh	420	460	8	8	13	261	1	1½	5	5	1660
Zaeyf	...	....	8	9	13	330	1	1½	6	5	2050

* If pump with iron water cylinder and steel piston rod is desired, add the word "Zabil." If pump with iron water cylinder, composition lining, piston and piston rod is desired, add the word "Zablu."

Outside Packed Plunger Pump

This pump is especially adapted for station duty in mines, and is far more durable than a piston pump for handling gritty water.

There are no wearing parts in the water end except the packing in the stuffing boxes, which can be instantly adjusted from the outside.

Since the plunger works in loose sleeves, the pump barrel cannot be cut or worn by grit or sand, and the stuffing boxes are placed in the center, so that there is no tendency for the plunger to sag. It is more compact than any other make of plunger pump, and has no outside rods or cross-heads. It is also adapted for feeding boilers under heavy pressure.

Code Word*	Size	Price with Iron Plunger and Steel Piston Rod	Price with Composition Plunger and Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Plunger, Inches	Stroke of Piston, Inches	Capacity at Ordinary Speed, per Minute, Gallons	Boilers, in Horse Power they will supply at moderate Speed, based on 30 lbs. of Water, per Horse Power per Hour	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Floor Space, Inches	Weight
Zaihv	A	$125	$150	4	2	6	12	60	⅜	½	1¼	1	53x10	283
Zaiit	B	220	250	6	3	7	28	140	¾	1	2	1½	59x13	551
Zaiko	B-B	270	300	7	3½	7	38	190	¾	1	2	1½	60x15	600
Zailb	....	325	375	7	3½	12	50	325	1	1½	3	2½	82x18	1200
Zaimk	C	375	425	8	4	12	65	425	1	1½	3	2½	82x18	1291
Zainh	D	475	550	10	5	13	100	670	1¼	2	4	3	91x23	1937
Zaiof	....	515	600	12	5	13	100	670	1½	2½	4	3	91x25	2173
Zaipd	....	500	575	8	6	13	150	1000	1	1½	4	3½	94x23	1960
Zairy	....	525	600	10	6	13	150	1000	1¼	2	4	3½	96x24	2150
Zaitu	E	625	750	12	6	18	150	1000	1½	2½	5	4	114x25	2995
Zaius	....	700	825	14	6	18	150	1000	2	3	5	4	126x27	3517
Zaivp	....	750	925	16	6	18	150	1000	2½	4	5	4	130x28	4000
Zaiwn	....	585	650	10	7	13	200	1325	1¼	2	5	4	99x26	2575
Zaiyj	E-E	625	700	12	7	13	200	1325	1½	2½	5	4	99x27	2735
Zaizm	....	650	750	12	7	18	200	1325	1½	2½	5	4	114x27	2970
Zajaj	....	675	775	14	7	13	200	1325	2	3	5	4	103x27	3135
Zajeb	....	700	800	14	7	18	200	1325	2	3	5	4	126x28	3505

* If pump with iron plunger and steel piston rod is desired, add the word "Zabil."
If pump with composition plunger and piston rod is desired, add the word "Zablu."

Vertical Plunger Sinking Pump

This is the most successful sinking pump that has ever been placed on the market. Any steam pump that is to be used in sinking a mine shaft must be strong, certain in operation, capable of handling gritty water, require little attention, and above all, be able to stand the roughest kind of usage without sustaining injury.

This pump retains all the advantages of the horizontal types of Cameron pumps besides having several features of importance for a sinking pump. It has no exposed parts liable to breakage; it takes up less room in the shaft than any other make of pump; it cannot be damaged by collision with the side walls; it is not likely to be injured by blasts; and it is designed and intended to handle gritty water.

Code Word	Size Number	Price with Iron Plunger and Steel Piston Rod	Diameter of Steam Cylinder, Inches	Diameter of Plunger, Inches	Stroke of Piston, Inches	Capacity at Ordinary Speed, per Minute, Gallons	Steam Pipe	Exhaust Pipe	Suction Pipe	Discharge Pipe	Space Occupied in Shaft, Inches	Weight
Zakec	5	$350	7	3½	12	50	1	1½	2½	2	24x24	1410
Zakiv	6	400	8	4	12	65	1	1½	3	2½	25x25	1435
Zakoh	7	500	10	5	13	100	1¼	2	4	3	31x30	2285
Zakra	..	575	12	5	13	100	1½	2½	4	3	32x33	2620
Zaksy	8	525	10	6	13	150	1¼	2	4	3½	31x31	2290
Zakyl	9a	575	12	6	13	150	1½	2½	4	3½	32x33	2545
Zakzo	..	675	14	6	13	150	2	3	4	3½	40x35	3600
Zalal	9	625	12	7	13	200	1½	2½	5	4	34x33	3400
Zalch	9b	675	14	7	13	200	2	3	5	4	40x35	3850
Zaled	..	750	16	7	16	200	2½	4	5	4	42x40	4650
Zalga	..	850	18	7	16	200	3	4	5	4	42x45	5000
Zalby	10	725	14	8	13	261	2	3	5	5	40x38	4150
Zaliw	11	800	16	8	16	261	2½	4	5	5	42x40	4750
Zalju	..	900	16	9	16	330	2½	4	6	5	42x45	5220
Zalks	12	1000	18	9	16	330	3	4	6	5	42x45	5575

CAMERON SUCTION CONDENSER

In mines, particularly, it is sometimes a very difficult matter to decide how to dispose of the exhaust steam.

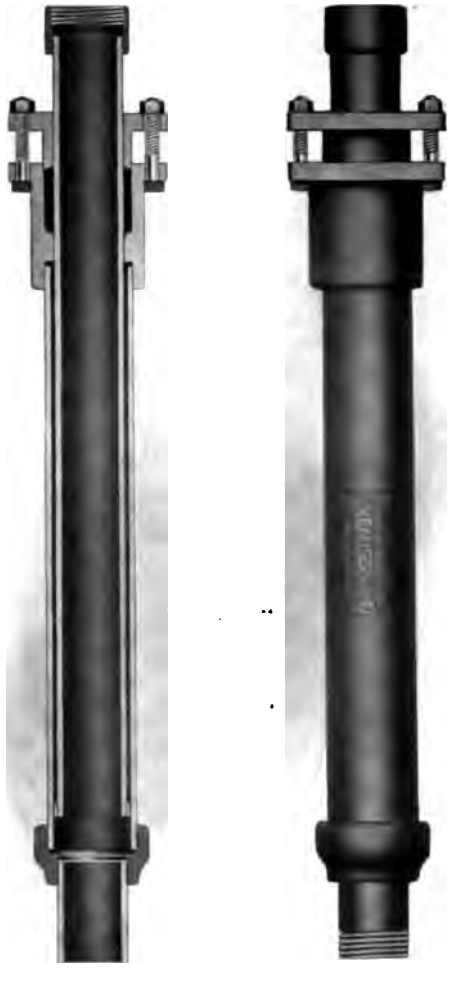
The use of a suction condenser offers a solution of the difficulty. The CAMERON Suction Condenser has the merit of not presenting any resistance to the free inflow of the water, while at the same time it is exceedingly effective in taking care of the exhaust steam by condensing it and permitting it to enter the pump as water, through the suction opening, from which it is discharged to the surface. It has also the additional advantage of relieving the steam end of back pressure, as a partial vacuum is formed proportionate to the height of suction lift.

Be sure that the water cylinder is fully charged before the exhaust steam is turned into the condenser by allowing the pump to exhaust into the atmosphere until the pump has become filled with water, when the three-way valve may be turned and the exhaust admitted to condenser.

An air leak is fatal to the successful working of this as of any condensing apparatus. The suction condenser and exhaust pipe leading thereto are shown by dark portion on cut herewith.

Suction Condenser Attached to Vertical Plunger Sinking Pump

Code Word	Size of Pump	Price with	of Condenser Exhaust Pipe	Exhaust Pipe	Suction Pipe	Weight
Zituk	6 x 3 x 7		.....	1	2	40
Zitvi	No. 5		.....	1½	2½	100
Zitze	" 6		.....	1½	3	100
Zityc	" 7		.....	2	4	150
Ziuac	12 x 5 x 13		.....	2½	4	150
Ziuba	No. 8		.....	2	4	150
Ziucy	" 9a		.....	2½	4	175
Ziueu	14 x 6 x 13		.....	3	4	175
Ziuft	No. 9		.....	2½	5	175
Ziuho	" 9b		.....	3	5	200
Ziuim	16 x 7 x 16		.....	4	5	250
Ziujk	No. 10		.....	3	5	225
Ziuki	" 11		.....	4	5	250
Ziulv	16 x 9 x 16		.....	4	6	250
Ziume	No. 12		.....	4	6	250



Telescopic Joint

CAMERON TELESCOPIC JOINT

This telescopic joint supplies a convenient means for lifting a pump when blasting, and avoids disconnecting the pipes. We usually make them for sixteen foot travel, to enable the operator to drop the pump that distance without disturbing the rest of the pipe. By its use irregular lengths of pipe may be added, whereas otherwise, when the pump is lowered, the pipe would have to be cut in equal lengths. The outside is made of galvanized pipe, and the inside of brass tubing when desired; or with both inside and outside pipes of galvanized iron.

Code Word	Diameter of Pipe. Inches	Length of Travel, Feet	Price, with Galvanized Iron Inner Tube	Price, with Brass Inner Tube	Weight
Ziynf	1¼	16	.....	.....	130
Ziyod	1½	16	.....	.....	175
Ziysu	2	16	.....	.....	220
Ziyts	2½	16	.....	.....	300
Ziyup	3	16	.....	.....	400
Ziywl	4	16	.....	.....	500
Ziyyh	5	16	.....	.....	600
Ziyzk	6	16	.....	.....	885
Zizah	8	16	.....	.....	1400

DETAILS OF CAMERON REGULAR AND BOILER FEED PUMPS

List of Details of Cameron Regular and Boiler Feed Pumps

In Ordering Parts:

1. Give *size number,* which will be found cast on valve chest bonnet.

2. Give *shop number,* which will be found stamped on valve chest bonnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

Part No.	Code Word	Parts
101	Zotoe	Steam cylinder for sizes 0 to 4a.
102	Zotur	Steam chest for sizes 0 to 4a.
103	Zotvo	Steam chest plunger.
104	Zotyl	Steam chest cover for sizes 0 to 4a.
105	Zoual	Steam chest crank and nut.
106	Zouce	Steam chest crank handle.
107	Zoudc	Steam chest, stuffing box bottom
108	Zouea	Steam chest, stuffing box cap.
109	Zoufz	Slide valve.
110	Zougx	Steam cylinder cover.
111	Zouhv	Reversing valve.
112	Zouit	Reversing valve bushing.
113	Zouko	Reversing valve cap for sizes 5 to 12.
114	Zoulb	Reversing valve plug for sizes 0 to 4a.
115	Zoumk	Steam piston head for sizes 0 to 4a, old style.
116	Zounh	Steam piston head, sizes 0 to 9, new style, with taper hole.
116a	Zouof	Steam piston follower, sizes 0 to 9, new style, straight hole. (Not shown.)
117	Zoupd	Steam piston head for sizes 10a to 12, and larger.
118	Zoury	Steam piston follower, sizes 0 to 4a, old style.
119	Zoutu	Steam piston follower, sizes 10a to 12, and larger.
120	Zouus	Steam piston packing ring, with wedge and spring, for sizes 0 to 4a, old style.
121	Zouvp	Steam piston packing ring for sizes 0 to 12, new style.
122	Zouwn	Steam piston bull ring for sizes 0 to 12, new style.
123	Zouyj	Piston rod and nuts.
124	Zouzm	Body piece for sizes 0 to 4a.
125	Zovaj	Piston rod, stuffing box gland.
126	Zoveb	Piston rod, stuffing box bottom.
127	Zovfa	Piston rod, stuffing box cap.
128	Zovgy	Piston rod, stuffing box thimble
129	Zovlu	Water cylinder for sizes 0 to 4a.
130	Zovni	Water cylinder cover for sizes 0 to 4a.
131	Zovog	Water cylinder bonnet.
132	Zovpe	Water piston head for sizes 0 to 10a.
133	Zovut	Water piston head for sizes 10 to 12.
134	Zovwo	Water piston follower for sizes 0 to 10a.
135	Zovyk	Water piston follower for sizes 10 to 12.
136	Zowak	Water valve, suction or discharge?
137	Zowbi	Water valve seat, suction or discharge?
138	Zowde	Water valve guard, suction or discharge?
139	Zowec	Water valve stem.
140	Zowiv	Water valve spring, suction or discharge?
141	Zowoh	Water valve stem plug for sizes 0 to 6.
141a	Zowra	Water valve stem plug for sizes 5b to 10a.
142	Zowsy	Water valve stem plug for sizes 10 to 12.
143	Zowuu	Air chamber.
144	Zowvs	Steam cylinder for sizes 5 to 12.
145	Zowzo	Steam chest for sizes 5 to 12.
146	Zoxal	Steam chest cover for sizes 5 to 12.
147	Zoxch	Body piece for sizes 5 to 12.
148	Zoxed	Water cylinder for sizes 5 to 12.
149	Zoxga	Water cylinder cover for sizes 5 to 12, round or oval.
150	Zoxhy	Discharge neck, with flange, for sizes 10 and larger.
151	Zoxiw	Water cylinder lining.
152	Zoxju	Removable bushing.

DETAILS OF CAMERON REGULAR PATTERN HORIZONTAL PLUNGER PUMPS

List of Details of Cameron Horizontal Plunger Pump—Regular Pattern

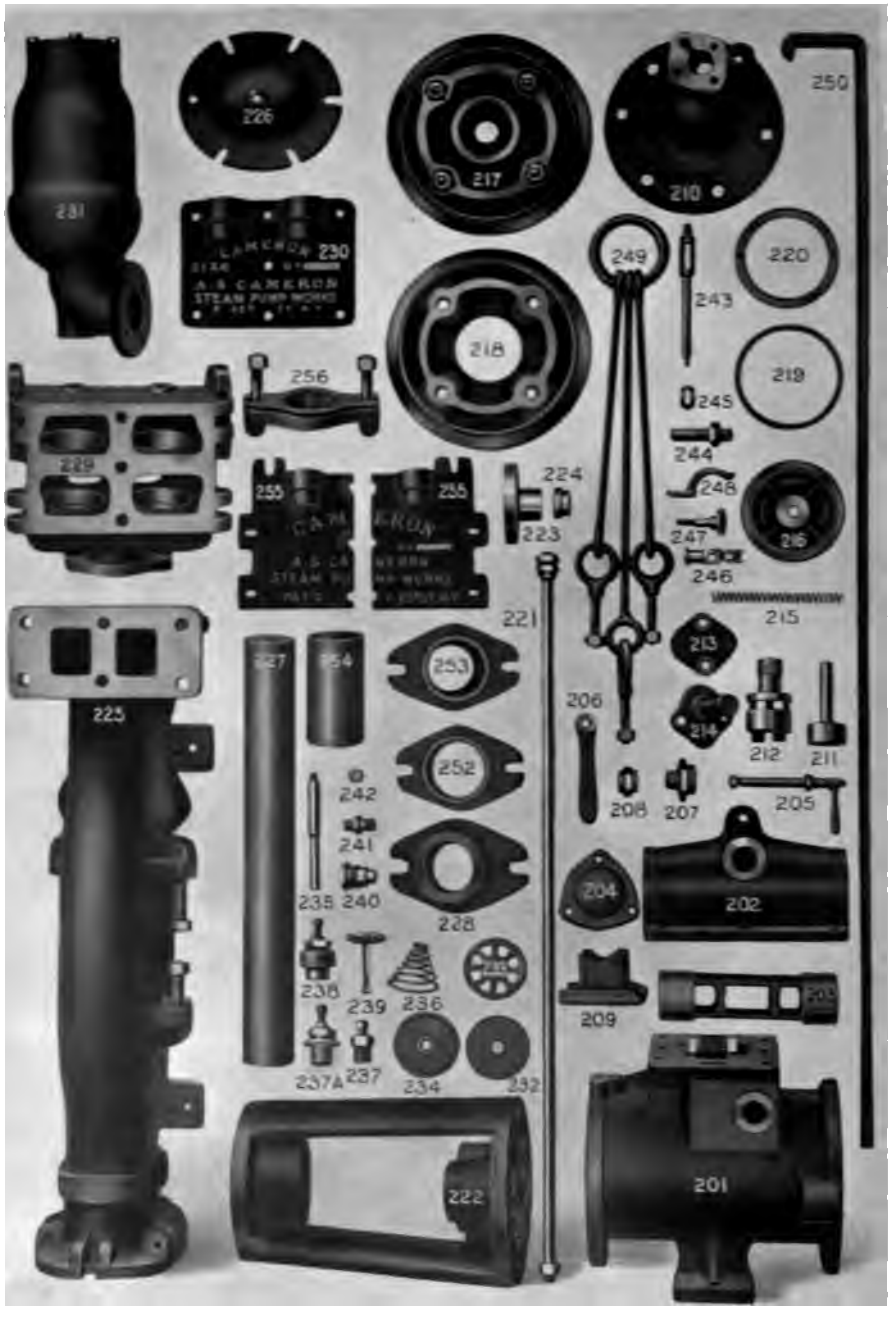
In Ordering Parts:

1. Give *size number,* which will be found cast on valve chest bonnet.

2. Give *shop number,* which will be found stamped on valve chest bonnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

Part No.	Code Word	Parts
401	Zoxks	Steam cylinder.
402	Zoxle	Steam chest.
403	Zoxol	Steam chest plunger.
404	Zoxuv	Steam chest cover.
405	Zoxxo	Steam chest crank and nut.
406	Zoxym	Steam chest crank handle.
407	Zoyam	Steam chest, stuffing box bottom.
408	Zoybk	Steam chest, stuffing box cap.
409	Zoycl	Slide valve.
410	Zoydg	Steam cylinder cover.
411	Zoyee	Reversing valve.
412	Zoyfd	Reversing valve bushing.
413	Zoygb	Reversing valve cap for 7x3½x 12 and larger.
414	Zoyhz	Reversing valve plug for sizes A, B and B-B.
415	Zoyix	Steam piston head for sizes A, B and B-B, old style.
416	Zoyjv	Steam piston head for sizes with steam cylinders 4" to 12" dia. The head has a taper hole.
416a	Zoykt	Steam piston follower for sizes with steam cylinder, 4" to 12" dia. The follower has a straight hole. (Not shown.)
417	Zoylf	Steam piston head for sizes with steam cylinders 14" dia. and larger.
418	Zoymo	Steam piston follower for sizes A, B and B-B, old style.
419	Zoyoj	Steam piston follower for sizes with steam cylinders 14" dia. and larger.
420	Zoyph	Steam piston packing ring, with wedge and spring for sizes A, B and B-B, old style.
421	Zoyrc	Steam piston packing ring for sizes with steam cylinders 4" dia. and larger.
422	Zoysa	Steam piston bull ring for sizes with steam cylinders 4" dia. or larger.
423	Zoyty	Piston rod and nuts.
424	Zoyuw	Body piece.
425	Zoyvu	Piston rod, stuffing box gland.
426	Zoyws	Piston rod, stuffing box bottom
427	Zoyxp	Piston rod, stuffing box cap.
428	Zoyyn	Piston rod, stuffing box thimble.
429	Zuaau	Water cylinder.
430	Zuabs	Water cylinder cover (round shape).
431	Zuacp	Water cylinder bonnet.
432	Zuael	Water cylinder cover (oval shape).
433	Zuafk	Blank suction flange.
434	Zuagl	Water plunger.
435	Zuahg	Water plunger gland.
436	Zuaie	Water valve.
437	Zuaka	Water valve seat, suction or discharge?
438	Zualm	Water valve guard, suction or discharge?
439	Zuant	Water valve stem.
440	Zuaor	Water valve spring, suction or discharge?
441	Zuapo	Water valve stem plug for sizes A to C.
441a	Zuarj	Water valve stem plug for sizes D to 18x7x18.
442	Zuash	Water valve stem plug for sizes F and larger.
443	Zuatf	Air chamber.
444	Zuaud	Discharge neck and flange.



DETAILS OF CAMERON VERTICAL PLUNGER SINKING PUMPS

List of Details of Cameron Vertical Plunger Sinking Pumps

In Ordering Parts:

1. Give *size number,* which will be found cast on valve chest bonnet.

2. Give *shop number,* which will be found stamped on valve chest bonnet, steam cylinder and body piece.

3. Give *name and number* of part from cut on opposite page.

Part No.	Code Word	Parts
201	Zuavb	Steam cylinder.
202	Zuawz	Steam chest.
203	Zuaxx	Steam chest plunger.
204	Zuayv	Steam chest cover.
205	Zuazy	Steam chest crank and nut.
206	Zubav	Steam chest crank handle.
207	Zubdo	Steam chest, stuffing box bottom
208	Zubem	Steam chest, stuffing box cap.
209	Zubif	Slide valve.
210	Zubnu	Steam cylinder cover.
211	Zubos	Reversing valve.
212	Zubsi	Reversing valve bushing.
213	Zubue	Reversing valve cap—top.
214	Zubwa	Reversing valve cap, with pipe —bottom.
215	Zubxy	Reversing valve spring.
216	Zubyw	Steam piston head for sizes 5 to 9a,—the head has a taper hole
216a	Zubzz	Steam piston follower for sizes 5 to 9a. Follower has straight hole. (Not shown.)
217	Zucaw	Steam piston head for sizes 9b to 12, and larger.
218	Zucbu	Steam piston follower for sizes 10 to 12, and larger.
219	Zuccs	Steam piston packing ring.
220	Zucen	Steam piston bull ring.
221	Zuchi	Piston rod with nuts.
222	Zucig	Body piece.
223	Zucje	Piston rod, stuffing box gland.
224	Zuclo	Piston rod, stuffing box thimble
225	Zucmy	Water cylinder barrel, with gland bolts.
226	Zucot	Water cylinder cover.
227	Zucth	Water plunger.
228	Zucuf	Water plunger gland (for pumps *without casing.*)
229	Zucvd	Water valve chest.
230	Zucyx	Water valve chest bonnet, one part.
231	Zucza	Air chamber, with discharge flange.
232	Zudax	Water valve.
233	Zudeo	Water valve seat, suction or discharge?
234	Zudih	Water valve guard, suction or discharge?
235	Zudou	Water valve stem.
236	Zudps	Water valve spring, suction or discharge?
237	Zudsk	Water valve stem plug for sizes 5 to 6.
237a	Zudti	Water valve stem plug for sizes 7 to 9b.
238	Zudug	Water valve stem plug for sizes 10 to 12.
239	Zudve	Priming valve with hand-wheel
240	Zudxa	Priming valve body.
241	Zueam	Priming valve, stuffing box bottom.
242	Zuecu	Priming valve, stuffing box cap
243	Zueds	Exhaust cut-off valve.
244	Zueep	Exhaust cut-off, stuffing box bottom.
245	Zuefo	Exhaust cut-off, stuffing box cap.
246	Zuegm	Exhaust cut-off lever.
247	Zuehk	Exhaust cut-off handle.
248	Zueil	Exhaust cut-off quadrant.
249	Zuejg	Slings.
250	Zueka	Hooks.
252	Zuema	Water plunger lower gland, for "casing" type.
253	Zuenx	Water plunger upper gland, for "casing" type.
254	Zueov	Water plunger casing.
255	Zuept	Water valve chest bonnet, two parts.
256	Zuern	Suction flange, with swing bolts.

USEFUL INFORMATION—STEAM

A cubic inch of water evaporated under atmospheric pressure is approximately converted into 1 cubic foot of steam.

The horse-power of boilers, as per standard adopted by the Am. S. M. E., is 30 pounds water evaporated per hour at a pressure of 70 pounds per square inch and from a temperature of 100 degrees Fahr.

Well designed boilers, under successful operation, will evaporate from 7 to 10 pounds of water per pound of first-class coal.

Each square foot of heating surface is considered sufficient to evaporate 2 pounds of water; therefore an engine using 30 pounds of water per horse-power per hour, each horse-power of the engine requires 15 square feet heating surface in the boiler.

On one square foot of fire grate can be burned on an average from 10 to 12 pounds hard coal, or 18 to 20 pounds soft coal, per hour, with natural draft.

Two and one-quarter pounds of dry wood is equal to 1 pound of average quality soft coal.

Steam engines consume from 12 to 50 pounds of feed water, and from 1¼ to 7 pounds of coal per hour per indicated horse-power.

Condensing engines require from 20 to 30 times the amount of feed water for condensing purposes; approximately for most engines, 1 to 1½ gallons condensing water per minute per indicated horse-power.

Surface condensers for compound steam engines require about 2 square feet of cooling surface per horse-power; ordinary engines will require more surface according to their economy in the use of steam. It is absolutely necessary that the air pump should be set lower than the condenser for satisfactory results.

The effect of a good air pump and condenser should be to get 25 inches of vacuum and to make available about 10 pounds more mean effective pressure with the same terminal pressure, or to give the same mean effective pressure with a correspondingly less terminal pressure. Approximately, a good condenser will save one-fourth of the fuel consumed, or, in other words, increase the power of the engine one-fourth, the fuel consumption remaining the same.

USEFUL INFORMATION—WATER

One cubic inch weighs .0361 pounds.

One pound = 27.7 cubic inches.

One cubic foot = 62.4245 pounds at 39 degrees Fahr.; 7.48 gallons U. S.; 6.2321 gallons imperial.

One gallon U. S. = 8.33111 pounds; 231 cubic inches; .13368 cubic feet.

One imperial gallon = 10 pounds at 62 degrees Fahr.; 277.274 cubic inches; .16046 cubic feet.

One pound pressure = 2.31 feet in height.

One foot in height = .433 pounds pressure.

Petroleum weighs 6½ pounds per U. S. gallon, 42 gallons to the barrel.

To convert imperial gallons into U. S. gallons, multiply by the factor 1.2. To convert U. S. gallons into imperial gallons, multiply by the factor .8333.

A miner's inch is a measure for flow of water, and is the quantity of water that will flow in one minute through an opening one inch square in a plank 2 inches thick under a head of 6½ inches to the centre of the orifice. This is equivalent, approximately, to 1.53 cubic feet, or 11½ gallons per minute.

To find the diameter of pump plungers to pump a given quantity of water at 100 feet piston speed per minute, divide the number of gallons by 4, then extract the square root, and the result will be the diameter in inches of the plungers.

To find the number of gallons delivered per minute by a single double-acting pump at 100 feet piston speed per minute, square the diameters of the plungers, then multiply by 4.

To find the horse power necessary to elevate water to a given height, multiply the weight of the water elevated per minute by the height in feet and divide the product by 33,000 (an allowance should be made for water friction and a further allowance for losses in the steam cylinder, say from 20 to 30 per cent.).

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inches, or a column of water 33.9 feet high at sea level.

To determine the proportion between the steam and pump cylinder, multiply the given area of the pump cylinder by the resistance on the pump in pounds per square inch, and divide the product by the available pressure of steam in pounds per square inch. The product equals the area of the steam cylinder. To this must be added an extra area to overcome the friction, which is usually taken at 25 per cent.

The resistance of friction in the flow of water through pipes of uniform diameter is independent of the pressure and increases *directly* as the length and the square of the velocity of the flow, and *inversely* as the diameter of the pipe. With wooden pipes the friction is 1.75 times greater than in metallic. Doubling the diameter increases the capacity four times.

To determine the velocity in feet per minute necessary to discharge a given volume of water in a given time, multiply the number of cubic feet of water by 144 and divide the product by the area of the pipe in inches.

To determine the area of a required pipe, the volume and velocity of water being given, multiply the number of cubic feet of water by 144 and divide the product by the velocity in feet per minute.

TABLE GIVING RATIOS OF AREAS

For given diameters of steam and water cylinders.

Diameter of Water Cylinders	DIAMETER OF STEAM CYLINDERS										
	3	3½	4	5	6	7	8	9	10	12	14
⅝	23.04	31.36	40.97	64.01	92.16	125.45	163.85	207.37	256.00	368.64	501.76
¾	16.00	21.77	28.45	44.45	64.00	87.12	113.78	144.00	177.77	256.00	348.44
⅞	11.75	16.00	20.90	32.66	47.02	64.01	83.60	105.80	130.61	188.09	256.00
1	9.00	12.25	16.0	25.0	36.00	49.01	64.00	81.00	100.00	144.00	196.00
1⅛	7.11	9.68	12.65	19.76	28.44	38.73	50.57	64.00	79.01	113.77	154.87
1¼	5.76	7.84	10.24	16.0	23.04	31.37	40.97	51.85	64.0	92.18	125.46
1⅜	4.76	6.48	8.46	13.23	19.04	25.92	33.85	42.84	52.89	76.16	103.66
1½	4.00	5.44	7.11	11.12	16.00	21.78	28.45	36.00	44.45	64.00	87.12
1⅝	3.41	4.64	6.06	9.47	13.63	18.56	24.24	30.68	37.87	54.53	74.22
1¾	2.94	4.0	5.23	8.17	11.75	16.00	20.90	26.45	32.66	47.03	64.00
1⅞	2.56	3.48	4.55	7.11	10.24	13.94	18.21	23.04	28.44	40.96	55.75
2	2.25	3.06	4.00	6.25	9.00	12.26	16.00	20.26	25.00	36.00	48.09
2¼	1.78	2.42	3.16	4.93	7.10	9.67	12.63	15.98	19.73	28.42	38.68
2½	1.44	1.96	2.56	4.0	5.76	7.84	10.24	12.96	16.0	23.04	31.35
2¾	1.19	1.62	2.12	3.31	4.76	6.48	8.46	10.72	13.22	19.04	25.92
3	1.00	1.36	1.78	2.78	4.0	5.43	7.11	9.00	11.11	16.0	21.77
3¼	.85	1.16	1.51	2.37	3.4	4.64	6.06	7.67	9.46	13.63	18.55
3½	.73	1.00	1.31	2.04	2.94	4.00	5.23	6.61	8.17	11.76	16.00
3¾	.64	.87	1.14	1.78	2.56	3.48	4.55	5.76	7.11	10.24	13.93
4	.56	.77	1.00	1.56	2.25	3.06	4.00	5.06	6.25	9.00	12.25
4¼	.50	.68	.89	1.38	1.99	2.71	3.54	4.49	5.53	7.97	10.85
4½	.44	.61	.79	1.23	1.78	2.42	3.16	4.00	4.94	7.11	9.68
4¾	.40	.54	.71	1.11	1.60	2.17	2.84	3.59	4.43	6.38	8.68
5	.36	.49	.64	1.00	1.44	1.96	2.56	3.24	4.00	5.76	7.84
5½	.30	.40	.53	1.00	1.19	1.62	2.12	2.68	3.30	4.76	6.48
6	.25	.34	.45	.83	1.00	1.36	1.78	2.25	2.78	4.00	5.45
6½	...	.29	.38	.69	.85	1.16	1.51	1.92	2.37	3.40	4.64
7	...	.25	.33	.59	.73	1.00	1.31	1.65	2.04	2.94	4.00
7½	...	...	.28	.51	.64	.87	1.14	1.44	1.78	2.56	3.48
8	...	...	.25	.44	.56	.77	1.00	1.27	1.56	2.25	3.06
8½	...	...	...	.39	.50	.68	.89	1.12	1.38	1.99	2.71
9	...	...	...	.35	.44	.60	.79	1.00	1.23	1.78	2.42
9½	...	...	...	.31	.40	.54	.71	.90	1.11	1.60	2.17
10	...	...	...	.28	.36	.49	.64	.81	1.00	1.44	1.96
10½	...	...	...	.25	.33	.44	.58	.73	.91	1.31	1.77
11	...	...	...	...	.30	.40	.53	.67	.83	1.19	1.62
12	...	...	...	...	.25	.34	.44	.56	.69	1.00	1.36
13	...	...	...	...	...	.29	.38	.48	.59	.85	1.16
14	...	...	...	...	...	.25	.33	.41	.51	.74	1.00
15	...	...	...	...	...	..	.28	.36	.44	.64	.87
16	...	...	...	...	...	...	.25	.32	.39	.56	.76
17	...	...	...	...	...	...	...	.28	.35	.50	.68
18	...	...	...	...	...	...	...	.25	.31	.45	.60

TABLE GIVING RATIOS OF AREAS—Continued

Diameter of Water Cylinders	DIAMETER OF STEAM CYLINDERS										
	16	18	20	22	24	26	28	30	32	34	36
5/8											
3/4	455.09										
7/8	334.37										
1	256.0	324.00	400.00								
1 1/8	202.27	256.00	316.05								
1 1/4	163.86	207.38	256.0	309.81							
1 3/8	135.39	171.47	211.69	256.00							
1 1/2	113.78	144.00	177.77	215.11	256.00						
1 5/8	96.94	122.72	151.54	183.37	218.22						
1 3/4	83.60	105.79	130.61	158.05	188.10	220.71					
1 7/8	72.82	92.16	113.78	137.67	163.85	192.29					
2	64.00	81.00	100.00	121.00	144.00	169.00	196.00	225.00	256.00		
2 1/4	50.56	64.00	79.01	95.60	113.78	131.56	154.87	177.77	202.27		
2 1/2	40.96	51.84	64.00	77.44	92.16	108.16	125.44	144.00	163.84	184.97	
2 3/4	33.85	42.84	52.89	64.00	76.17	89.39	103.66	119.01	135.41	152.86	
3	28.44	36.00	44.44	53.77	64.00	75.11	87.11	100.00	113.77	128.44	144.00
3 1/4	24.23	30.67	37.87	45.83	54.54	64.00	74.24	85.22	96.96	109.46	122.72
3 1/2	20.90	26.44	32.65	39.42	47.02	55.18	64.00	73.47	83.59	94.36	105.79
3 3/4	18.20	23.04	28.44	34.42	40.96	48.07	55.75	64.00	72.82	82.21	92.16
4	16.00	20.25	25.00	30.25	36.00	42.25	49.00	56.25	64.00	72.25	81.00
4 1/4	14.17	17.93	22.14	26.79	31.89	37.43	43.41	46.51	56.69	64.00	71.76
4 1/2	12.64	16.00	19.75	23.90	28.44	33.33	38.71	44.44	50.56	57.08	64.00
4 3/4	11.34	14.36	17.73	21.45	25.53	29.96	34.75	39.89	45.38	51.24	57.44
5	10.24	12.96	16.00	19.20	23.04	27.04	31.36	36.00	40.96	46.24	51.84
5 1/2	8.46	10.71	13.22	16.00	19.04	22.33	25.91	29.75	33.85	38.21	42.84
6	7.11	9.00	11.11	13.44	16.00	18.77	21.77	25.00	28.44	32.11	36.00
6 1/2	6.06	7.66	9.46	11.45	13.63	16.00	18.56	21.30	24.23	27.36	30.67
7	5.22	6.61	8.16	9.87	11.75	13.79	16.00	18.37	20.90	23.59	26.44
7 1/2	4.55	5.76	7.11	8.60	10.24	12.00	13.93	16.00	18.20	20.55	23.04
8	4.00	5.06	6.25	7.25	9.00	10.56	12.25	14.06	16.00	18.06	20.25
8 1/2	3.54	4.48	5.53	6.69	7.97	9.35	10.85	12.45	14.17	16.00	17.92
9	3.15	4.00	4.93	5.98	7.11	8.34	9.67	11.11	12.64	14.27	16.00
9 1/2	2.83	3.59	4.43	5.36	6.38	7.49	8.68	9.97	11.34	12.88	14.36
10	2.56	3.24	4.00	4.84	5.76	6.76	7.84	9.00	10.24	11.56	12.96
10 1/2	2.32	2.94	3.63	4.39	5.22	6.13	7.10	8.16	9.29	10.48	11.75
11	2.11	2.67	3.30	4.00	4.76	5.58	6.47	7.43	8.46	9.55	10.71
12	1.77	2.25	2.77	3.36	4.00	4.67	5.44	6.25	7.11	8.02	9.00
13	1.51	1.91	2.37	2.86	3.40	4.00	4.63	5.32	6.06	6.83	7.66
14	1.30	1.65	2.04	2.46	2.93	3.44	4.00	4.59	5.22	5.89	6.61
15	1.13	1.44	1.77	2.13	2.56	3.00	3.48	4.00	4.55	5.13	5.76
16	1.00	1.26	1.56	1.89	2.25	2.64	3.06	3.51	4.00	4.51	5.06
17	.88	1.12	1.38	1.67	1.99	2.34	2.71	3.11	3.54	4.00	4.48
18	.79	1.00	1.23	1.49	1.77	2.08	2.41	2.77	3.15	3.56	4.00

FRICTION LOSS IN POUNDS PRESSURE PER SQUARE INCH

For each 100 feet of length in different size clean iron pipes discharging given quantities of water per minute.

Gallons Discharged per Minute	½ Inch Friction Loss in Pounds	¾ Inch Friction Loss in Pounds	1 Inch Friction Loss in Pounds	1¼ Inch Friction Loss in Pounds	1½ Inch Friction Loss in Pounds	2 Inch Friction Loss in Pounds	2½ Inch Friction Loss in Pounds	3 Inch Friction Loss in Pounds	3½ Inch Friction Loss in Pounds	4 Inch Friction Loss in Pounds	5 Inch Friction Loss in Pounds	6 Inch Friction Loss in Pounds	Gallons Discharged per Minute
5	24.6	3.3	.84	.31	.12	.....	.....	.....	.....	.....	.....	.....	5
10	96.0	13.0	3.16	1.05	.47	.12	.....	.....	.....	.....	.....	.....	10
15	.....	28.7	6.98	2.38	.97	.....	.....	.....	.....	.....	.....	.....	15
20	.....	50.4	12.3	4.07	1.66	.42	.....	.....	.....	.....	.....	.....	20
25	.....	78.0	19.0	6.40	2.62	.....	.21	.10	.....	.....	.....	.....	25
30	.....	.....	27.5	9.15	3.75	.91	.....	.....	.....	.....	.....	.....	30
35	.....	.....	37.0	12.04	5.05	.....	.....	.....	.....	.....	.....	.....	35
40	.....	.....	48.0	16.1	6.52	1.60	.....	.....	.....	.....	.....	.....	40
45	.....	.....	.....	20.2	8.15	.....	.....	.....	.....	.....	.....	.....	45
50	.....	.....	.....	24.9	10.0	2.44	.81	.35	.16	.09	.03	.....	50
75	.....	.....	.....	56.1	22.4	5.32	1.80	.74	.34	.....	.....	.....	75
100	.....	.....	.....	.....	39.0	9.46	3.20	1.31	.60	.33	.12	.....	100
125	.....	.....	.....	.....	.....	14.9	4.89	1.99	.90	.....	.....	.05	125
150	.....	.....	.....	.....	.....	21.2	7.0	2.85	1.32	.69	.25	.10	150
175	.....	.....	.....	.....	.....	28.1	9.46	3.85	1.78	.....	.....	.....	175
200	.....	.....	.....	.....	.....	37.5	12.48	5.02	2.32	1.22	.....	.17	200
250	.....	.....	.....	.....	.....	.....	19.66	7.76	3.55	1.89	.42	.46	250
300	.....	.....	.....	.....	.....	.....	28.06	11.2	5.23	2.66	.65	.37	300
350	.....	.....	.....	.....	.....	.....	.....	15.2	7.0	3.65	.93	.50	350
400	.....	.....	.....	.....	.....	.....	.....	19.5	9.0	4.73	1.28	.65	400
450	.....	.....	.....	.....	.....	.....	.....	25.0	11.60	6.01	1.68	.81	450
500	.....	.....	.....	.....	.....	.....	.....	30.8	14.26	7.43	2.10	.96	500
											2.70		

FRICTION LOSS IN POUNDS PRESSURE PER SQUARE INCH

For each 100 feet of length in different size clean iron pipes discharging given quantities of water per minute.

Gallons Discharged per Minute	5 Inch	6 Inch	8 Inch	10 Inch	12 Inch	14 Inch	16 Inch	18 Inch	20 Inch	24 Inch	30 Inch	Gallons Discharged per Minute
	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	Friction Loss in Pounds	
250	.65	.26	.07	.03	.01	....	....	....	....	....	....	250
500	2.70	.96	.25	.09	.04	.017	.009	.005	....	....	....	500
750	5.40	2.21	.53	.18	.08	....	....	....	....	....	....	750
1,000	9.60	3.88	.94	.32	.13	.062	.036	.020	.012	.005	.002	1,000
1,250	....	....	1.46	.49	.20	....	....	....	....	....	....	1,250
1,500	....	....	2.09	.70	.29	.135	.071	.040	....	....	....	1,500
1,750	....	....	....	.95	.38	....	....	....	....	....	....	1,750
2,000	....	....	....	1.23	.49	.234	.123	.071	.042	.020	.006	2,000
2,250	....	....	....	....	.63	....	....	....	....	....	....	2,250
2,500	....	....	....	....	.77	.362	.188	.107	....	....	....	2,500
3,000	....	....	....	....	1.11	.515	.267	.150	.091	.047	.012	3,000
3,500	....	....	....	....	....	.697	.365	.204	....	....	....	3,500
4,000	....	....	....	....	....	.910	.472	.263	.158	.067	.022	4,000
4,500	....	....	....	....	....	....	.593	.333	....	....	....	4,500
5,000	....	....	....	....	....	....	.730	.408	.244	.102	.035	5,000
6,000	....	....	....	....	....	....	....	.585	.348	.146	.048	6,000
7,000	....	....	....	....	....	....	....	....	.472	.196	.065	7,000
8,000	....	....	....	....	....	....	....	....	.612	.255	.083	8,000
9,000	....	....	....	....	....	....	....	....	....	.323	.105	9,000
10,000	....	....	....	....	....	....	....	....	....	.396	.131	10,000

HEIGHTS IN FEET TO WHICH PUMPS WILL ELEVATE WATER

Steam pressure, 50 pounds per square inch at the pump. No allowance made for friction in pipes, etc.

Diameter of Steam Cylinders	DIAMETER OF WATER CYLINDERS																
	2 Inch	2½ Inch	3 Inch	3½ Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	10½ Inch	12 Inch	14 Inch	16 Inch	18 Inch	20 Inch
3½	230	147	102	75	58	37											
4	300	192	134	134	75	48	34										
5	469	300	209	153	117	75	52	38									
6	675	432	300	221	169	108	75	55	42	33							
7	920	588	408	300	230	147	102	75	57	45	37						
8	...	768	533	344	300	192	141	98	75	59	48	44					
9	...	972	675	496	380	243	169	124	95	75	61	55	42				
10	...	...	833	612	469	300	208	153	117	94	75	68	50	38			
12	...	...	...	881	675	432	300	220	169	133	108	97	75	55	42		
14	...	...	...	...	920	588	408	300	228	182	147	133	102	75	57	45	
16	...	...	...	...	...	768	564	392	300	236	192	174	141	98	75	59	48
18	...	...	...	...	...	972	650	490	379	300	243	220	162	122	95	75	61
20	...	...	...	...	...	...	833	600	469	370	300	272	208	150	117	92	75
22	...	...	...	...	...	...	1008	741	567	448	364	329	252	185	142	112	91
24	...	...	...	...	...	...	...	882	675	533	432	392	300	220	169	133	108
26	...	...	...	...	...	...	...	1034	788	626	508	460	356	258	197	156	127
28	...	...	...	...	...	...	...	...	919	726	588	533	407	300	230	181	147
30	...	...	...	...	...	...	...	...	1054	834	676	612	468	345	263	208	169
32	...	...	...	...	...	...	...	...	...	948	768	697	533	391	300	237	192
34	...	...	...	...	...	...	...	...	...	1070	868	786	603	442	339	268	217
36	...	...	...	...	...	...	...	...	...	...	972	881	675	495	380	300	243

The maximum limit of piston speed depends upon the head pumped against.

PRESSURE OF WATER

The pressure of water in pounds per square inch for every foot in height to 260 feet; and then, by intervals, to 3,000 feet head. By this table, from the pounds pressure per square inch, the feet head is readily obtained, and *vice versa*.

Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch	Feet Head	Pressure per Square Inch
1	0.43	54	23.39	107	46.34	160	69.31	213	92.20	285	123.45
2	0.86	55	23.82	108	46.78	161	69.74	214	92.69	290	125.62
3	1.30	56	24.26	109	47.21	162	70.17	215	93.13	295	127.78
4	1.73	57	24.69	110	47.64	163	70.61	216	93.56	300	129.95
5	2.16	58	25.12	111	48.08	164	71.04	217	93.99	305	132.12
6	2.59	59	25.55	112	48.51	165	71.47	218	94.43	310	134.28
7	3.03	60	25.99	113	48.94	166	71.91	219	94.86	315	136.46
8	3.46	61	26.42	114	49.38	167	72.34	220	95.30	320	138.62
9	3.89	62	26.85	115	49.81	168	72.77	221	95.73	325	140.79
10	4.33	63	27.29	116	50.24	169	73.20	222	96.16	330	142.95
11	4.76	64	27.72	117	50.68	170	73.64	223	96.60	335	145.12
12	5.20	65	28.15	118	51.11	171	74.07	224	97.03	340	147.28
13	5.63	66	28.58	119	51.54	172	74.50	225	97.46	345	149.45
14	6.06	67	29.02	120	51.98	173	74.94	226	97.90	350	151.61
15	6.49	68	29.45	121	52.41	174	75.37	227	98.33	355	153.78
16	6.93	69	29.88	122	52.84	175	75.80	228	98.76	360	155.94
17	7.36	70	30.32	123	53.28	176	76.23	229	99.20	365	158.10
18	7.79	71	30.75	124	53.71	177	76.67	230	99.63	370	160.27
19	8.22	72	31.18	125	54.15	178	77.10	231	100.0	375	162.45
20	8.66	73	31.62	126	54.58	179	77.53	232	100.49	380	164.61
21	9.09	74	32.05	127	55.01	180	77.97	233	100.93	385	166.78
22	9.53	75	32.48	128	55.44	181	78.40	234	101.36	390	168.94
23	9.96	76	32.92	129	55.88	182	78.84	235	101.70	395	171.11
24	10.39	77	33.35	130	56.31	183	79.27	236	102.23	400	173.27
25	10.82	78	33.78	131	56.74	184	79.70	237	102.66	425	184.10
26	11.26	79	34.21	132	57.18	185	80.14	238	103.09	450	195.0
27	11.69	80	34.65	133	57.61	186	80.57	239	103.53	475	205.77
28	12.12	81	35.08	134	58.04	187	81.0	240	103.96	500	216.58
29	12.55	82	35.52	135	58.48	188	81.43	241	104.39	525	227.42
30	12.99	83	35.95	136	58.91	189	81.87	242	104.83	550	238.25
31	13.42	84	36.39	137	59.34	190	82.30	243	105.26	575	249.09
32	13.86	85	36.82	138	59.77	191	82.73	244	105.69	600	259.90
33	14.29	86	37.25	139	60.21	192	83.17	245	106.13	625	270.73
34	14.72	87	37.68	140	60.64	193	83.60	246	106.56	650	281.56
35	15.16	88	38.12	141	61.07	194	84.03	247	106.99	675	292.40
36	15.59	89	38.55	142	61.51	195	84.47	248	107.43	700	303.22
37	16.02	90	38.98	143	61.94	196	84.90	249	107.86	725	314.05
38	16.45	91	39.42	144	62.37	197	85.33	250	108.29	750	324.88
39	16.89	92	39.85	145	62.81	198	85.76	251	108.73	775	335.72
40	17.32	93	40.28	146	63.24	199	86.20	252	109.16	800	346.54
41	17.75	94	40.72	147	63.67	200	86.63	253	109.59	825	357.37
42	18.19	95	41.15	148	64.10	201	87.07	254	110.03	850	368.20
43	18.62	96	41.58	149	64.54	202	87.50	255	110.46	875	379.03
44	19.05	97	42.01	150	64.97	203	87.93	256	110.89	900	389.86
45	19.49	98	42.45	151	65.40	204	88.36	257	111.32	925	400.70
46	19.92	99	42.88	152	65.84	205	88.80	258	111.76	950	411.54
47	20.35	100	43.31	153	66.27	206	89.21	259	112.19	975	422.35
48	20.79	101	43.75	154	66.70	207	89.66	260	112.62	1000	433.18
49	21.22	102	44.18	155	67.14	208	90.10	261	113.06	1500	649.7
50	21.65	103	44.61	156	67.57	209	90.53	262	113.49	2000	866.3
51	22.09	104	45.05	157	68.0	210	90.96	270	116.96	3000	1,299.5
52	22.52	105	45.48	158	68.43	211	91.39	275	119.12		
53	22.95	106	45.91	159	68.87	212	91.83	280	121.29		


CAMERON